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18 SEP REC'D

EDN

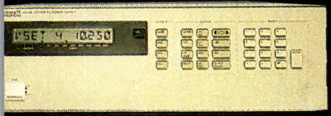
SPECIAL ISSUE—Part 1
Product Showcase No 23

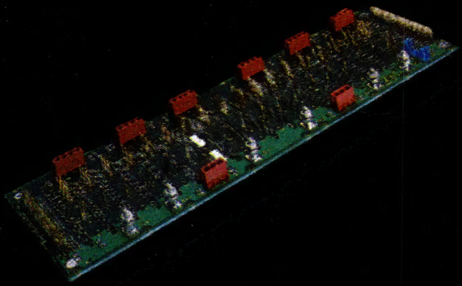
Highlighting key trends in power sources, software, ICs & semiconductors, and hardware & interconnects

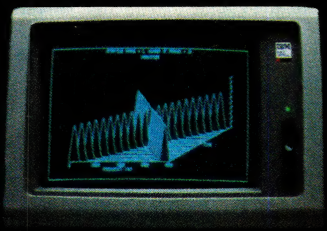
Expanded literature section

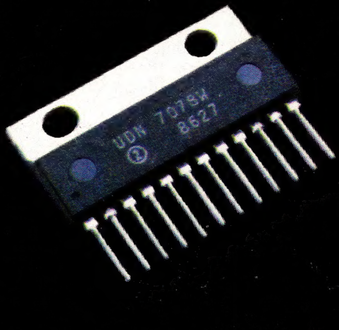
ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS

Showcase

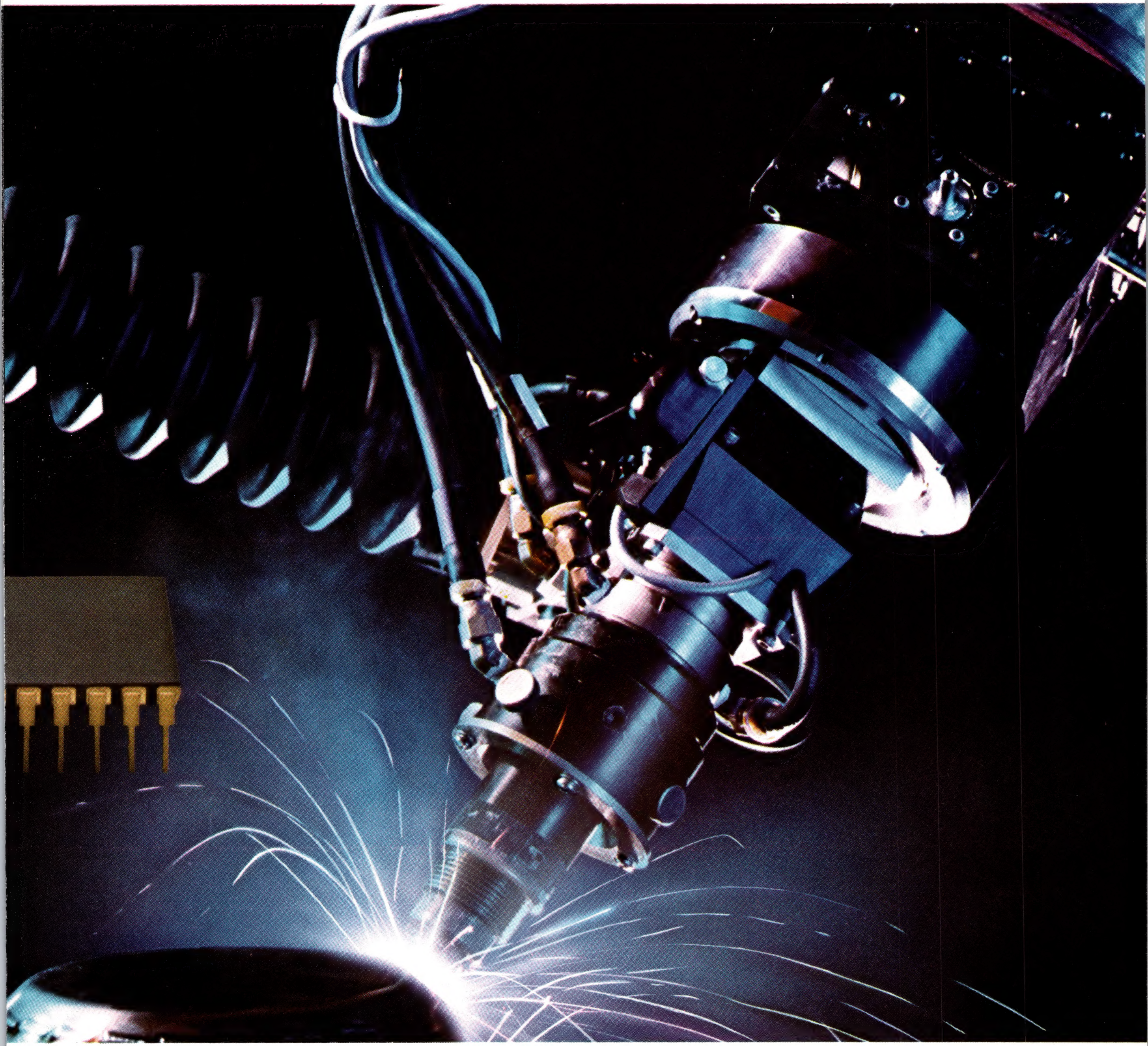








stands alone.



error correction technique, the ICL7134 provides up to 14 bits of accuracy and ultra-high stability over the entire operating temperature range. Plus the same cool low-power CMOS performance.

Right now, we've got plenty of stock available. So once you see how easily the ICL7115 interfaces to your hardwired system and hooks up to 8- or 16-bit buses, you can spec the A/D chip that stands without peer.

Matter of fact, give us a call today and we'll put this super A/D converter in your hands. After all, we designed the ICL7115 for great engineers. Like you.

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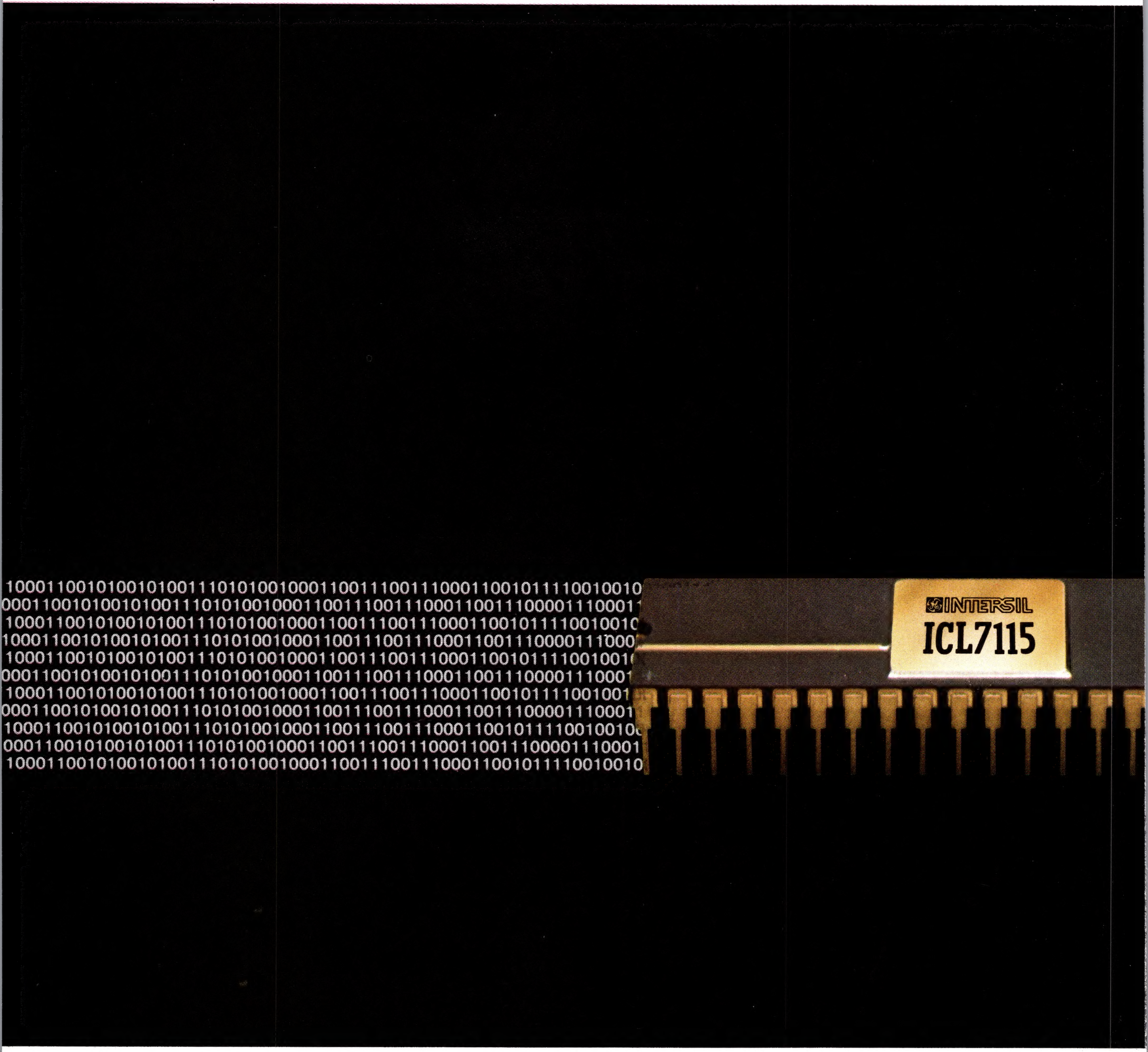

The only 14-bit monolithic A/D converter on the market today—that's Intersil's ICL7115. It's the chip that will change the definition of signal processing.

Data acquisition and data logging applications are a whole new ball game with the ICL7115. It's monolithic, which means lower cost and higher reliability than systems built with hybrids or modules. And its successive approximation technique gives you 25,000 conversions per second, for more rapid sampling and greater digitizing capabilities.

The key to the ICL7115 is our proprietary EPROM error correction technique. Unlike conventional techniques such as laser trimming, this unique EPROM correction method compensates for linearity and full-scale error with greater precision and stability, over the entire operating temperature range.

Though it's a hot new product, the ICL7115 is a very cool performer: thanks to our advanced CMOS technology, the whole package dissipates only 10mW.

And if your system requires equal precision in a D/A converter, our ICL7134 meets the challenge. Utilizing the same proprietary EPROM

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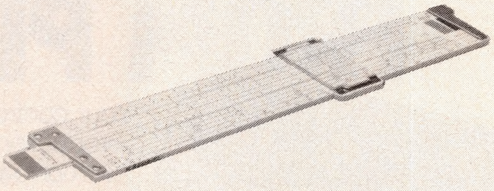
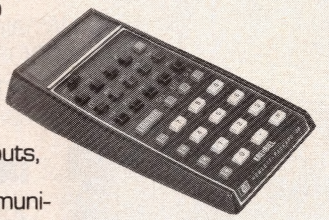
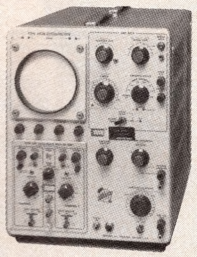
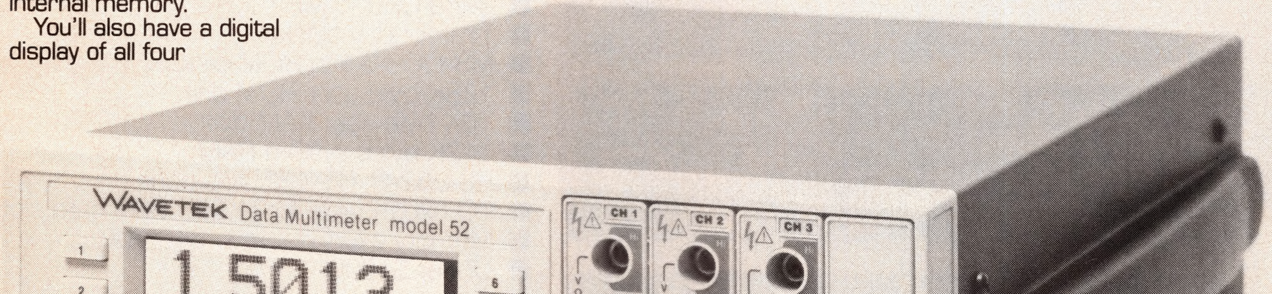
For details about this engineering milestone, call or write Wavetek San Diego, Inc., 9045 Balboa Ave., P.O. Box 85265, San Diego, CA 92138.
Tel. (619) 279-2200; TWX 910-335-2007.

*U.S. price only.









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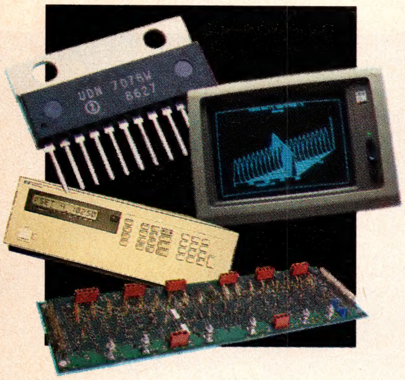
Volume 31, Number 14

EDN

July 10, 1986

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS



On the cover: *Part 1 of this Product Showcase issue begins with coverage of ICs and Semiconductors; that section leads off with a staff report on high-voltage ICs (pg 74), illustrated on the cover by a 150V, 3A quad Darlington driver from Sprague Electric Co. An FFT display generated by Signal Technology Inc's ILS package highlights our staff report on DSP filter software (pg 152), which leads off the Software section, and a Hewlett-Packard lab/bench supply indicates the focus of our report on Power Sources (pg 186). Finally, a high-speed backplane from Hybricon illustrates our report on Hardware and Interconnect Devices (pg 222). (Cover concept by Debi Queally; photography by Gerry Baskin)*

DESIGN FEATURES

ICs and Semiconductors

High-voltage circuits use mixed processes, fulfill diverse roles 74

Various high-voltage monolithic ICs simplify design tasks by taking over the roles of circuits that once required large numbers of discrete components. These ICs use a variety of processes, including bipolar, CMOS, DMOS, and combinations thereof. For functions hard to realize in IC form, hybrids are the solution.—*Bill Travis, Senior Editor*

Software

DSP-filter software offers design help to novices 152

A hands-on evaluation of some of today's digital-signal-processing software shows how those unfamiliar with the mathematical complexities of DSP filters can quickly arrive at serviceable designs.—*Robert H Cushman, Special Features Editor*

Power Sources

Lab/benchtop power supplies offer a wide range of functions 186

This year's programmable lab and benchtop dc power supplies offer more features than ever before. Designers who don't require such extras as multiple outputs or a GPIB interface, however, can still choose from a variety of less-expensive models that provide only basic features and offer extra features as options.—*J D Mosley, Regional Editor*

Hardware and Interconnect Devices

Backplanes play a crucial role in high-speed systems 222

The backplane is no longer simply a mounting surface for daughter boards; instead, it's an important component in a sophisticated connection system. Because of the fast switching speeds and high circuit densities prevalent in today's applications, the backplane you select seriously affects your system's electrical performance.—*Tom Ormond, Senior Editor*

Continued on page 7

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Enhanced capabilities for new applications.

The new 8842A is so technologically superior, it can outperform DMMs costing twice as much. Its capabilities include 0.003% 1-year basic accuracy and 100 nV resolution for dc voltage measurements. And it incorporates exclusive new thin film resistors* for a two-year calibration cycle.

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Choose either model for under $1,000.

The 8840A starts at $760, the 8842A at $995. With inexpensive IEEE-488 and true RMS AC options available for both models.

Which one is right for you? The choice may not be easy.

But at least now, it's a family decision.

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Talk to our sales engineers about the 8840A and the new 8842A. Take advantage of our **no-risk 15-day trial period.**

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0.005% basic dc accuracy (1 Yr.)		0.003% basic dc accuracy (1 Yr.)	
0.16% basic ac accuracy (1 Yr.)		0.08% basic ac accuracy (1 Yr.)	
0.013% basic ohms accuracy (1 Yr.)		0.008% basic ohms accuracy (1 Yr.)	
Resolution to 1μV dc, 10μA dc, 1mΩ		Resolution to 100nV dc, 1μA dc, 100μΩ	
One-year specifications and warranty		Two-year specifications and warranty	
8840A	$760	8842A	$995
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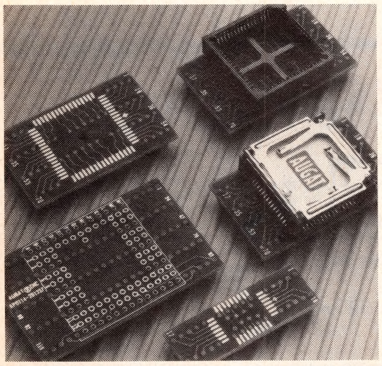
Continued from page 5

EDN

July 10, 1986



This Product Showcase issue *highlights significant new products in four categories: ICs and Semiconductors (pg 91), Software (pg 165), Power Sources (pg 197), and Hardware and Interconnect Devices (pg 231).*

PRODUCT UPDATE

QIC-120 tape drive 53
Single-chip T1 interface 54
Power-MOSFET sense terminal 56
Knock-down vertical enclosures 58
4k×4-bit static RAM 60

PRODUCT REVIEWS

ICs and Semiconductors 91
Software 165
Power Sources 197
Hardware and Interconnect Devices 231

DESIGN IDEAS

Three ICs form portable RF burst generator 256
Finite differences simplify look-up table 258
Circuit offers precision chopper control 260
Low-power RS-232C driver operates from 5V 262
Timer IC provides low-power voltage monitor 262

LITERATURE

Components 266
Computers and Peripherals 278
ICs and Semiconductors 283
Products from Europe 284

Continued on page 9

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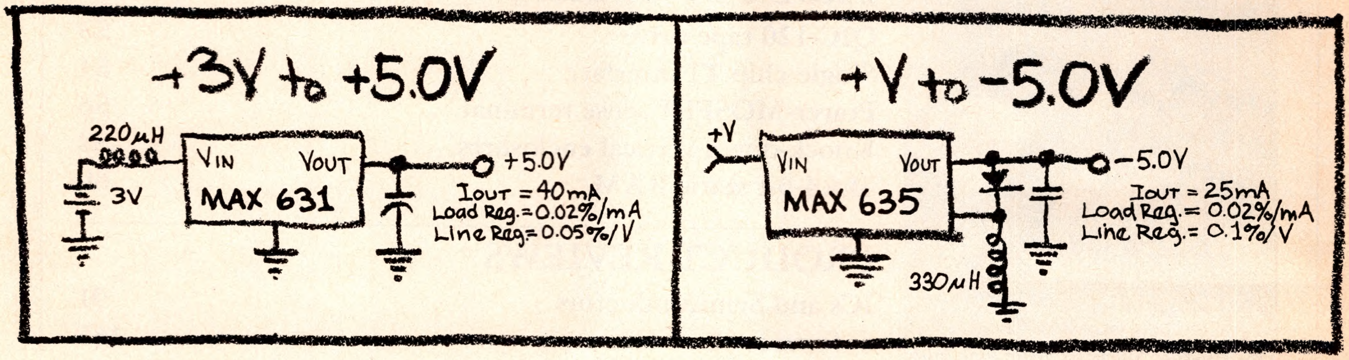
ANY VOLTAGE IN.
ANY VOLTAGE OUT.



Maxim's family of CMOS DC-DC power converters can handle any input and generate any regulated output voltage (up to 100mA out or several amps with an external MOSFET).

They don't need potentiometers, because the outputs are pretrimmed to the most frequently used voltages (5V, 12V and 15V). And instead of complex transformer circuitry, an inexpensive off-the-shelf coil will do. What's more, with 80% efficiency and 90µA quiescent current, they're perfect for battery-powered applications.

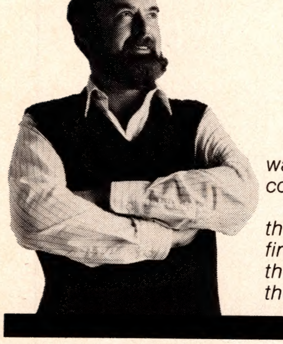
Now that you're converted, simply call your Maxim representative or distributor for samples and datasheets.

Maxim Integrated Products, 510 N. Pastoria Avenue, Sunnyvale, CA 94086,
(408) 737-7600.

Maxim DC-DC Converters

DEVICE	INPUT VOLTAGE	OUTPUT VOLTAGE	COMMENTS	PRICE (100 up)
STEP UP CONVERTERS				
MAX630	2.0V to 16.5V	Vout > Vin	Programmable O/P, precision ref.	$3.20
MAX631	2.0V to 5.6V	+5V	Only 2 external components	$3.50
MAX632	2.0V to 12.6V	+12V	Only 2 external components	$3.50
MAX633	2.0V to 15.6V	+15V	Only 2 external components	$3.50
MAX641	2.0V to 5.6V	+5V	10 Watts w/external MOSFET	$3.72
MAX642	2.0V to 12.6V	+12V	10 Watts w/external MOSFET	$3.72
MAX643	2.0V to 15.6V	+15V	10 Watts w/external MOSFET	$3.72
MAX4193	2.4V to 16.5V	Vout > Vin	Programmable output	$2.15
INVERTING CONVERTERS				
MAX634	3.0V to 16.5V	up to −20V	Programmable O/P, precision ref.	$2.90
MAX635	3.0V to 16.5V	−5V	Only 3 external components	$3.50
MAX636	3.0V to 16.5V	−12V	Only 3 external components	$3.50
MAX637	3.0V to 16.5V	−15V	Only 3 external components	$3.50
MAX4391	4.0V to 16.5V	up to −20V	Programmable output	$2.70
STEP DOWN CONVERTERS				
MAX638	3.0V to 16.5V	Vout < Vin	Only 3 external components	$3.50

MAXIM



Maxim's family of DC-DC converters was developed under the direction of Maxim co-founder and VP of R&D, Dave Fullagar.

At Fairchild, back when giants walked the earth, Dave helped pioneer the world's first linear ICs. And he personally designed the most successful op amp ever built, the µA741.

What's more, as Intersil's first engineering director, he was responsible for the emergence of CMOS as the standard technology for analog ICs.

Add to all that the fact that Dave is 6'3." And I guess you could say that Dave is a giant in the annals of analog IC technology.

Whatever an annal is.

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CIRCLE NO 116

Continued from page 7

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EDITORIAL 47

One stereotype of engineers portrays them as fascinated with technology and gadgets to the exclusion of other concerns, including the effects of their profession on other people. But countering this stereotype is the emergence of organizations that help engineers deal with the broader nature of their labors.

PROFESSIONAL ISSUES 293

As engineers' social consciousness matures, concerned groups act as the guiding light.—*Deborah Asbrand, Staff Editor*

LOOKING AHEAD 305

Circuit-board market growth precedes radical applications . . . MIL-spec connector market to be worth $1.8B by 1990.

DEPARTMENTS

News Breaks 19
News Breaks International 22
Signals & Noise 30
Calendar 38
Leadtime Index 66
Business/Corporate Staff 292
Career Opportunities 297
Advertisers Index 304

A product-oriented design aid

To save you time in your efforts to keep current, EDN's editors have surveyed the new-product offerings from thousands of companies, screening and selecting only the most significant of those offerings introduced in the last six months. We present our findings — the best of the best — in a format devised to make your product selection as easy as possible. You can keep this Product Showcase as a reference until the next one that covers these four key product areas appears in December.

BPA ABP

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Sam Shine, Proprietor

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Customer	Product	Quality Rating for Samtec
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Company "B"	Industrial Controls	100%
Company "C"	Test Instrumentation	100%
Company "D"	Cellular Radios (Telecom)	100%
Company "E"	Medical Instrumentation	100%
Company "F"	Computers	Zero Defects
Company "G"	Telecommunications	100%
Company "H"	Industrial Motors	100%
Company "I"	Telecommunications	100%
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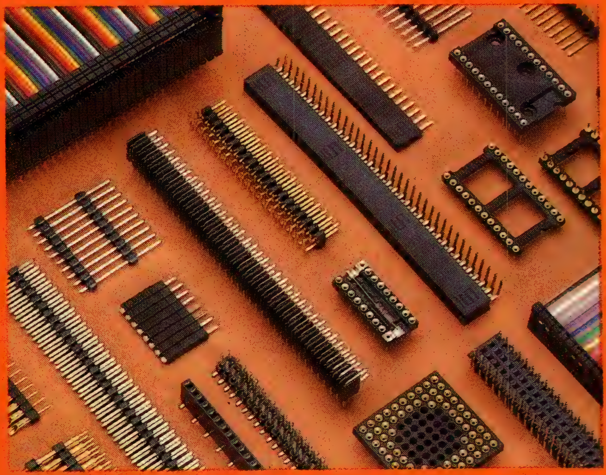

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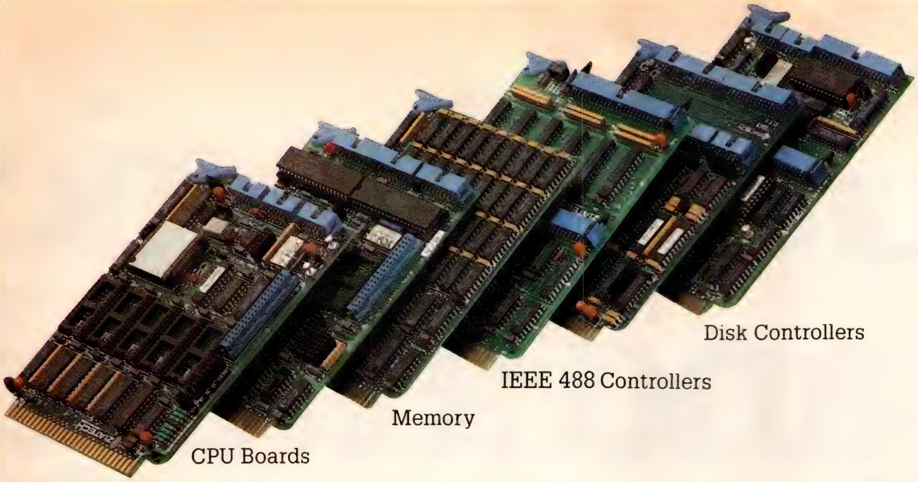

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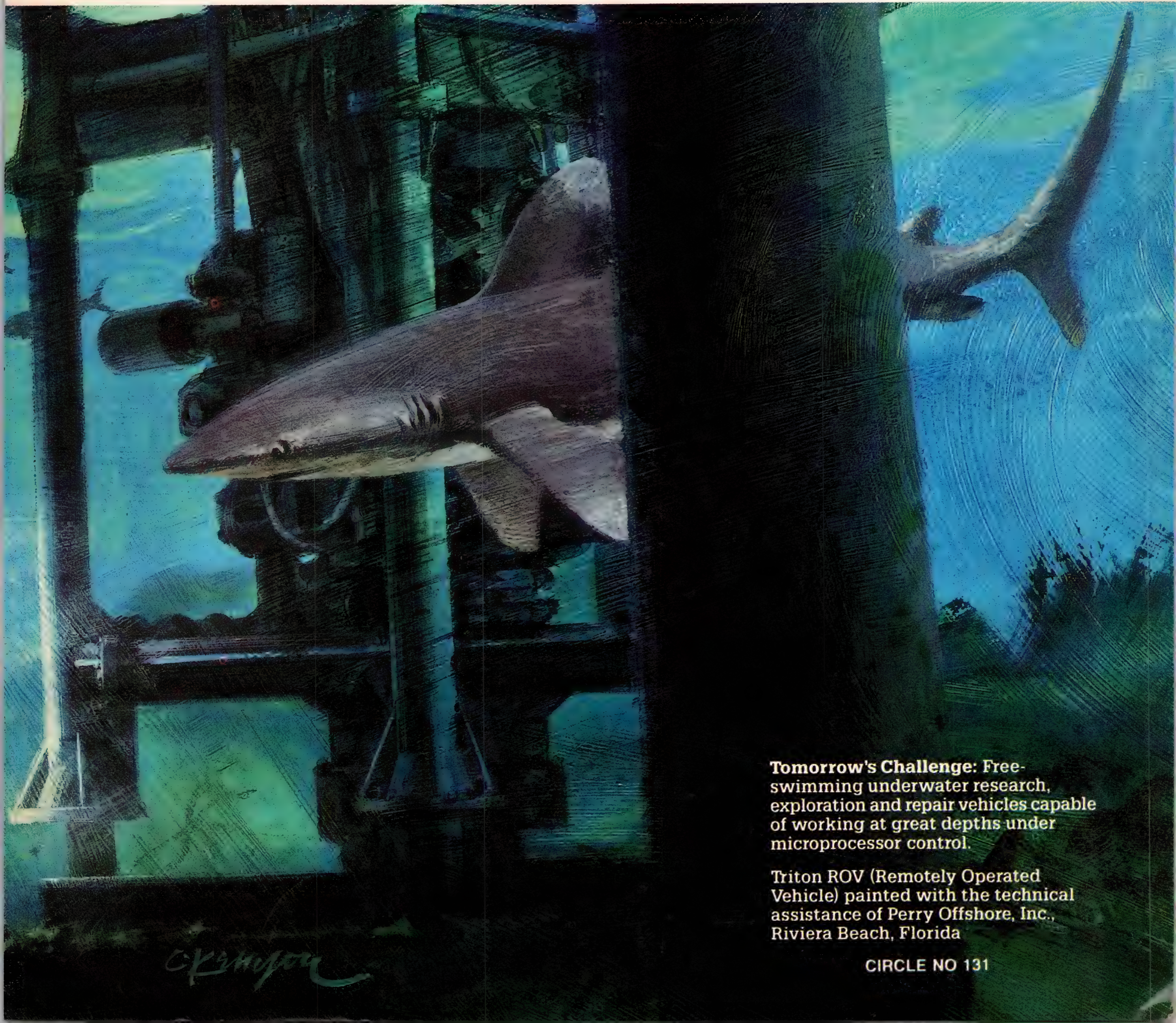

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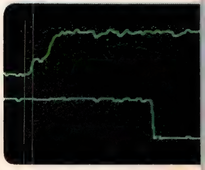
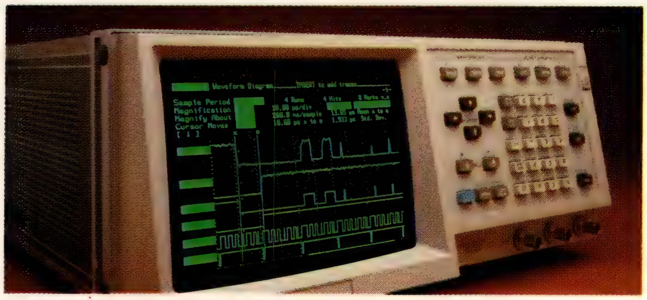


The HP 1631 A/D.



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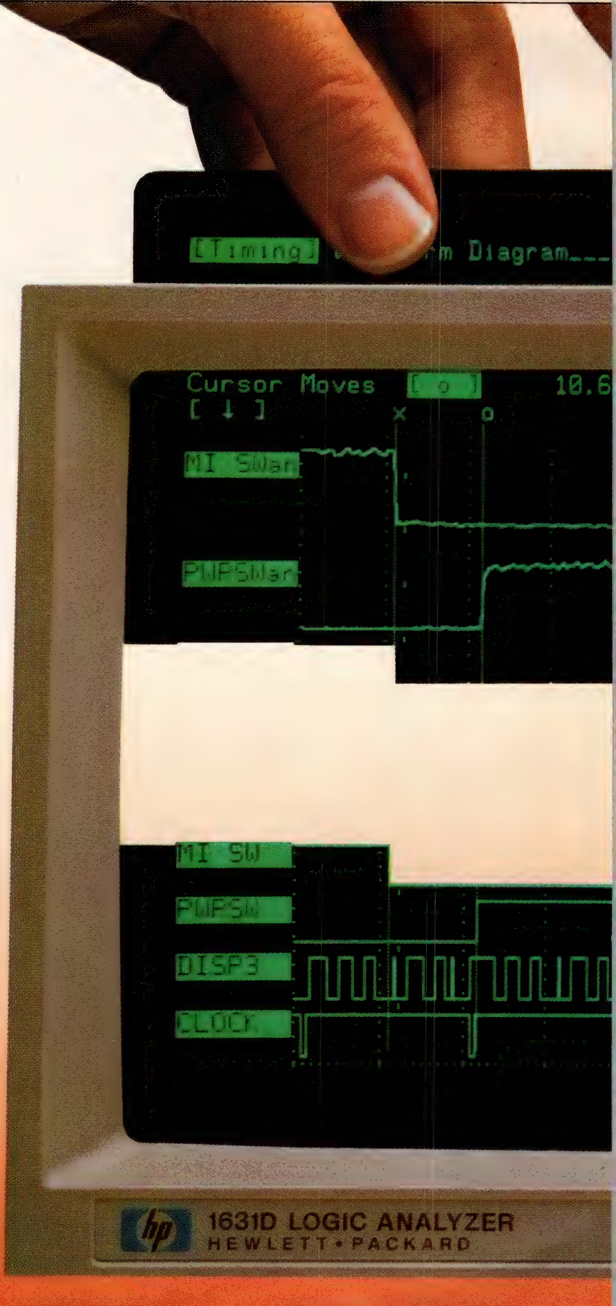

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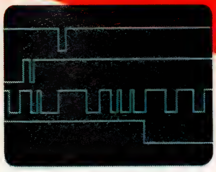

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People tend to get a bit excited when they hear that Monolithic Memories is getting into CMOS.

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featuring zero standby power and 35ns maximum propagation delay, better than anything our competition has yet offered.

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Why are we doing all this, you ask?

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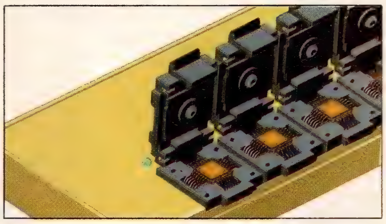
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NEWS BREAKS

EDITED BY JOAN MORROW

GaAs MSI ICs ELIMINATE ECL-CIRCUIT TIMING BOTTLENECKS

Gigabit Logic (Newbury Park, CA, (805) 499-0610) will add the 10G022, a 1.5-GHz octal shift register, to its Picologic product line in August. You can use this device and other Picologic GaAs ICs to eliminate timing bottlenecks in ECL-circuit designs, specifically in parallel-to-serial conversions that require a shift register that's faster than the circuit generating the parallel data. The 10G022 is more than three times faster than a comparable ECL part; it will cost approximately $200 (100).—Margery S Conner

CMOS MICROPROGRAM SEQUENCER IS 20% FASTER THAN 2910A

The CMOS CY7C910 microprogram sequencer from Cypress Semiconductor Corp (San Jose, CA) is compatible with the bipolar 2910A from Advanced Micro Devices (Sunnyvale, CA), but it has a 20% shorter minimum clock-cycle time than the 2910A—40 vs 50 nsec. In addition, the CMOS IC consumes only 100 mA max, which is less than one-third of the power required by the bipolar IC (340 mA max). The CY7C910 is pin compatible and functionally equivalent to the 2910A, so it is suitable for designs using 2901 bit-slice μPs. It comes specified for commercial or military temperature ranges and is packaged in 40-pin plastic or ceramic DIPs or 44-pin leadless chip carriers. Commercial 40-nsec parts cost $17.25; military 46-nsec parts cost $60.45 (100).—David Smith

16-BIT μP AND DISK CONTROLLER ADDED TO TRANSPUTER FAMILY

Inmos (Colorado Springs, CO) has added the IMS T212 16-bit μP and the IMS M212 disk processor to the Transputer family. The $400 IMS T212 combines a 16-bit RISC-like μP core with 2k bytes of onboard static RAM, four high-speed serial interprocessor link ports, and a 16- or 8-bit-wide external memory interface in a 68-pin pin-grid-array (PGA) package. You can program the IMS T212 with Inmos's C, Pascal, Fortran, and occam languages.

The $300 IMS M212 is a programmable disk controller that supports floppy-disk and hard-disk drives with ST506/412HP interfaces and incorporates two interprocessor links. An onboard ROM supplies the low-level firmware required for disk control and the operation of the interprocessor links. You program the IMS M212 using one of the Inmos high-level language compilers. The IMS M212 is also supplied in a 68-pin PGA package.—Steven H Leibson

64k-BIT STATIC RAMs FEATURE 25-nSEC ACCESS TIMES

Fabricated using silicon-gate, 1.5-μm CMOS technology, the MCM6287 and MCM6288 from Motorola (Austin, TX, (512) 928-6000) come in 25-, 35-, and 45-nsec access-time versions. The 6287 is organized as a 64k×1-bit RAM, and the 6288 features a 16k×4-bit structure. They come in three package types: a 300-mil, 22-lead ceramic sidebraze; a plastic DIP; and a ceramic leadless chip carrier. The 6287 draws 50 mA ac max, and the 6288 draws 80 mA ac max. Both dissipate 1W. The 25-nsec versions cost $43, and the 45-nsec devices cost $32 (OEM qty).—J D Mosley

TI TO ENTER HIGH-DENSITY MILITARY-POWER-SUPPLY MARKET

Texas Instruments (Dallas, TX) expects to enter the high-density power-supply market late this year or early in 1987 with military line-replaceable modules. Designed for use in high-density digital subsystems, these modules will offer a 10:1 space reduction compared to discrete power supplies with equivalent performance. To help reduce power-supply size, TI uses custom-designed low-profile magnetic components in the switching supplies. Now under evaluation, the 1.2-lb HVS-200 will provide 200W at 2, 3, or 5V to yield a power density between 10 and 15W/in³. Currently, most discrete military power supplies offer densities between 1 and 3W/in³.—Jon Titus

DC/DC CONVERTER FEATURES 15 TO 65V DC INPUT VOLTAGE RANGE

The first monolithic dc/dc converter for the Integrated Services Digital Network (ISDN), the Am7936 from Advanced Micro Devices (Sunnyvale, CA, (408) 732-2400), accepts 15 to 65V dc and provides a regulated 5V dc supply to circuits in the ISDN terminal. The device, the first part in a family of products for the ISDN, is compatible with the CCITT power requirements for the S interface, which connects telecommunications terminal equipment to the PABX. You can also program the chip to provide a regulated supply at other voltage levels—as much as 80% of the input voltage. The Am7936 can detect polarity reversal resulting from a power loss and can signal the μP to shut off power in nonpriority terminals. The Am7936 costs $15.75 (100).—J D Mosley

BiMOS GATE ARRAY COMBINES CMOS LOGIC AND BIPOLAR I/O

The MCA6000ETL gate array combines CMOS logic gates with bipolar transistors that increase switching speeds and generate TTL and ECL I/O signal levels. Motorola Inc (Mesa, AZ) combines CMOS and bipolar circuits in a BiMOS process to create an array that works at bipolar speeds and signal levels but takes advantage of the lower power and higher noise margins of CMOS circuits. The chip drives TTL or ECL signals with delays of 1.25 and 5.5 nsec, respectively. Internal signals experience an intrinsic gate delay of 0.9 nsec through CMOS gates that have bipolar output stages. The output stages reduce the signal delay's dependence on loading, thereby increasing the performance of heavily loaded lines such as clock and enable signals. Power consumption is 1.7 to 6W typ, depending on the number of ECL output signals. Development cost is $50,000 typ; turnaround time from verified layout is 10 to 13 weeks.—David Smith

GRAPHICS INTERFACE IN ROM SUITS TMS 34010-BASED BOARDS

The DGIS*34010 ROM kit from Graphics Software Systems Inc (Beaverton, OR, (503) 641-2200) implements the Direct Graphics Interface Specification (DGIS) for graphics controller boards using the Texas Instruments TMS 34010 graphics processor chip. DGIS allows any DOS-based graphics application with installable drivers to support any PC or PC/AT graphics board that has a DGIS ROM. The ROM kit costs $4 to $10.

DGIS was developed by a consortium of board, software, and IC manufacturers in an attempt to standardize the interface between intelligent graphics boards and the IBM PC. Supporters include Intel, TI, Lotus, Paradise, and Borland.—Margery S Conner

LASER PROCESS ADDS INTERCONNECTIONS AND RESISTORS TO ICs

The Microelectronics Group at Lincoln Laboratory, Massachusetts Institute of Technology (Lexington, MA), uses a laser to deposit tungsten interconnections and polysilicon resistors on electronic devices. The laser-assisted process can modify or repair CMOS gate arrays, analog and digital GaAs devices, and hybrid circuits. Because the laser can insert vias and add layers, the process can handle ICs that include single and multiple layers of interconnections. Deposition of interconnections requires no modification of existing ICs; the direct-writing process requires no lithography. For a 1-μm tungsten layer, the process has a 100-μm/sec deposition rate.—Eva Freeman

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Use the TDC1025 in applications such as digital oscilloscopes, transient recorders, automatic test equipment and high-speed radar systems. The TDC1025 and TDC1025E1C are available off the shelf from Arrow Electronics, Hall-Mark and Hamilton/Avnet.

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NEWS BREAKS: INTERNATIONAL

BY PETER HAROLD

INTERFACE LINKS VAX COMPUTERS TO OPTICAL DISKS

Providing SCSI interface hardware and a set of software modules, the GDV optical-disk driver from MC2 (Grenoble, France, TLX 980809) allows you to interface an ATG Gigadisc drive to VAX computers. Interface cards are available for Unibus and Q Bus systems, so the interface can be used with VAX 11/700 Series or MicroVAX computers. The software interface includes a VMS 4.2 Gigadisc driver; data-management software that takes account of the WORM (write-once read-many) characteristic of the optical disk; user-callable routines, which allow you to create, open, or close files or to read or write records; and a set of DCL commands for disk and media management. The GDV software supports multiuser access to 16 Gigadisc drives operating in parallel.

EUROPEAN COMPANIES JOIN FORCES TO PROMOTE ASICs

Matra-Harris Semiconducteurs (Nantes, France, TLX 711930) and Plessey Semiconductors (Swindon, UK, TLX 449637) have signed a joint agreement to provide mutual second sourcing for their application-specific ICs (ASICs). Under the agreement, the companies will have the right to use each other's 2-μm, double-layer metal CMOS process, together with their respective gate-array and standard-cell libraries, which will include the transfer of Plessey's Megacell library to Matra-Harris. During the next six months, the companies will work to establish a common cell library and CAD tools for a sub-1.2-μm process.

COLOR-GRAPHICS BOARD FEATURES 1600×1280-PIXEL DISPLAY FORMAT

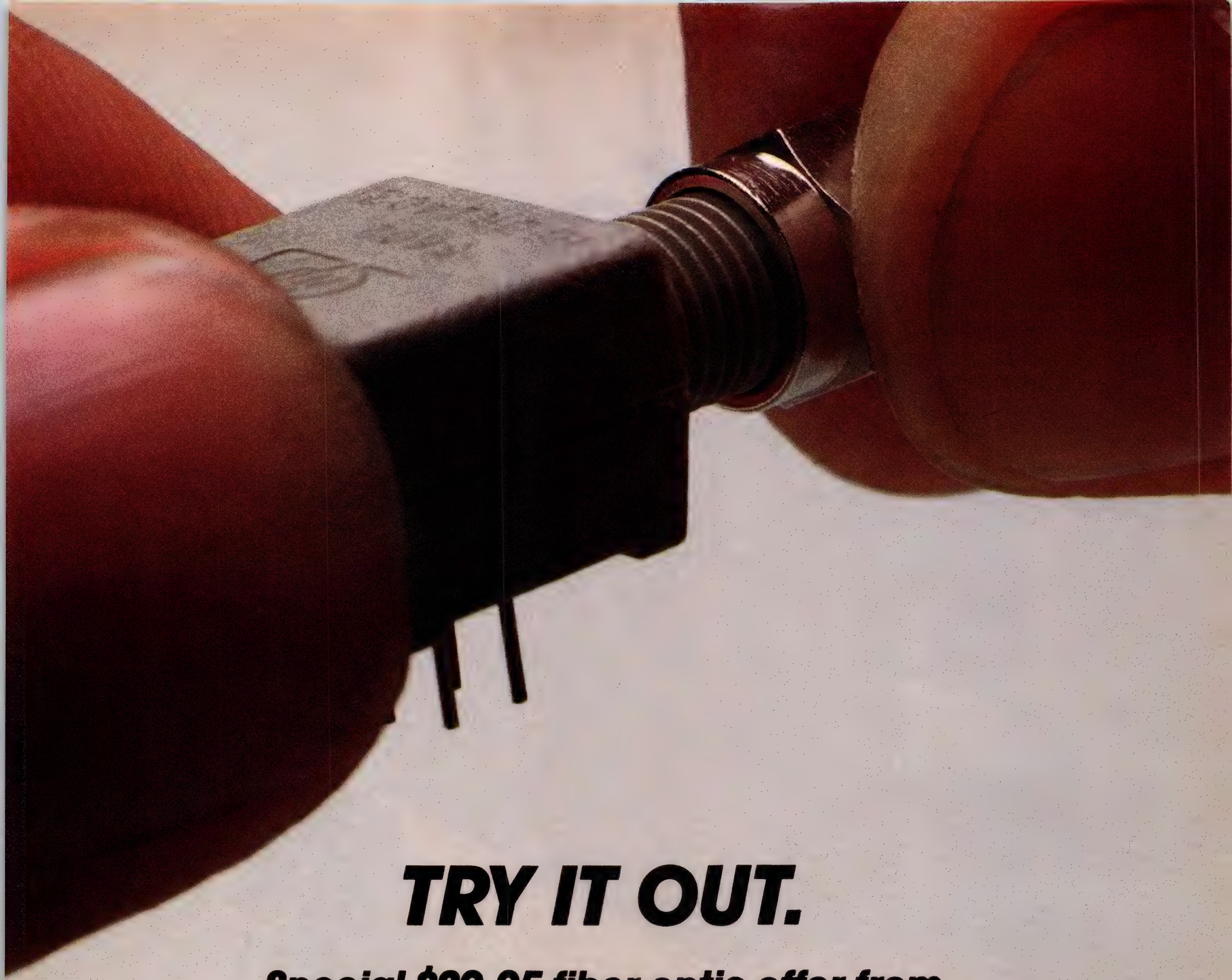
The SYS68K/AGC-1 VME Bus graphics controller subsystem from Force Computers (Ottobrunn, West Germany, TLX 524190, and Los Gatos, CA) provides 1600×1280-pixel interlaced or 1024×800-pixel noninterlaced display formats, suiting it for use with 1280×1024-pixel high-resolution color monitors. The 4 bits/pixel and onboard color look-up table allow you to display as many as 16 colors from a palette of 16 million. At a reduced display resolution, you can operate the controller at 8 bits/pixel to simultaneously display as many as 256 colors from the same palette. The system features hardware for scroll, zoom, split-screen, window, cursor, and light-pen functions. The graphics controller is expected to sell for around DM 13,000.

PLUG-IN BOARDS ALLOW VOCAL COMMUNICATION WITH A PC

The SDPC-300 and SDPC-600 plug-in boards from Speech Design (Germering, West Germany, TLX 898931) sell for approximately DM 1000 and provide IBM PC or compatible computers with speech-recognition and -reproduction capabilities. The SDPC-300 employs variable-slope delta-modulation techniques, and the SDPC-600 uses pulse-code modulation to reproduce the speech output. PC-based software provided with the boards allows you to establish a vocabulary of recognizable and reproducible words or sounds.

CELLULAR-RADIO TEST SET COVERS MOST INTERNATIONAL STANDARDS

By combining the 4922 radio-code analyzer with its Stabilock 4040 communications test set, Solartron Instruments (Farnborough, UK, TLX 858245) offers a fully automated test set for cellular radios. Priced from £16,000, the menu-driven test set allows you to analyze all cellular-radio test parameters down to the bit level, with results displayed in graphical or numerical form on the 4922's CRT or a printer. Test facilities conform to all the major international standards.



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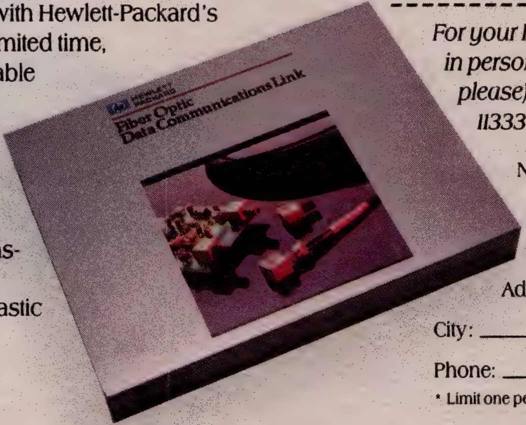

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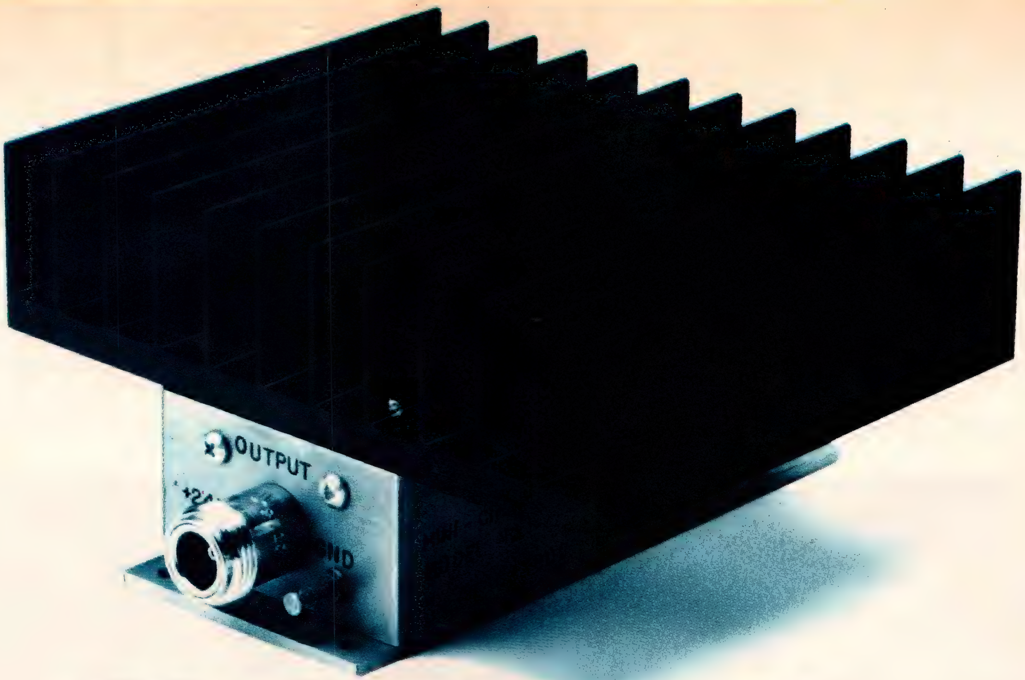

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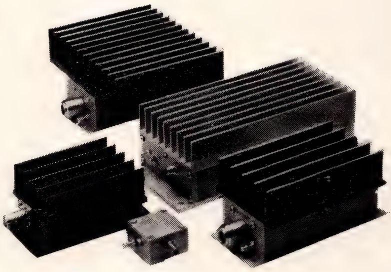

Model No.	Freq. MHz	Gain dB	Gain Flatness dB	Max. Power Output 1dBm Compression	Noise Figure dB	Intercept Point, Typ. 3rd Order	DC Power		Price	
							Voltage	Current	$ Ea.	Qty.
ZHL-32A	0.05-130	25 Min.	±1.0 Max.	+29 dBm Min.	10 Typ.	+38 dBm	+24V	0.6A	199.00	(1-9)
ZHL-3A	0.4-150	24 Min.	±1.0 Max.	+29.5 dBm Min.	11 Typ.	+38 dBm	+24V	0.6A	199.00	(1-9)
ZHL-1A	2-500	16 Min.	±1.0 Max.	+28 dBm Min.	11 Typ.	+38 dBm	+24V	0.6A	199.00	(1-9)
ZHL-2	10-1000	15 Min.	±1.0 Max.	+29 dBm Min.	18 Typ.	+38 dBm	+24V	0.6A	349.00	(1-9)
ZHL-2-8	10-1000	27 Min.	±1.0 Max.	+29 dBm Min.	10 Typ.	+38 dBm	+24V	0.65A	474.00	(1-9)
ZHL-2-12	10-1200	24 Min.	±1.0 Max.	+29 dBm Min.	10 Typ.	+38 dBm	+24V	0.75A	599.00	(1-9)
ZHL-1-2W	5-500	29 Min.	±1.0 Max.	+33 dBm Min.	12 Typ.	+44 dBm	+24V	0.9A	495.00	(1-9)
ZHL-42	700-4200	30 Min.	±1.0 Max.	+29 dBm Min.	7.5 Typ.	+38 dBm	+15V	0.69A	895.00	(1-9)
ZHL-7-2W	600-800	28 Min.	±1.0 Max.	+33 dBm Min.	12 Typ.	+43 dBm	+24V	0.9A	525.00	(1-9)
ZFL-2000	10-2000	20 Min.	±1.5 Max.	+17 dBm Min.	7 Typ.	+25 dBm	+15V	0.1A	179.00	(1-9)

C70 REV. B

50 ohm impedance,
input and output VSWR 2: 1 max.

Price and specifications
subject to change without notice.

Refer to EEM and Gold Book for detailed specs.

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CIRCLE NO 135

Only Mentor Graphics accelerates CAE across the board.

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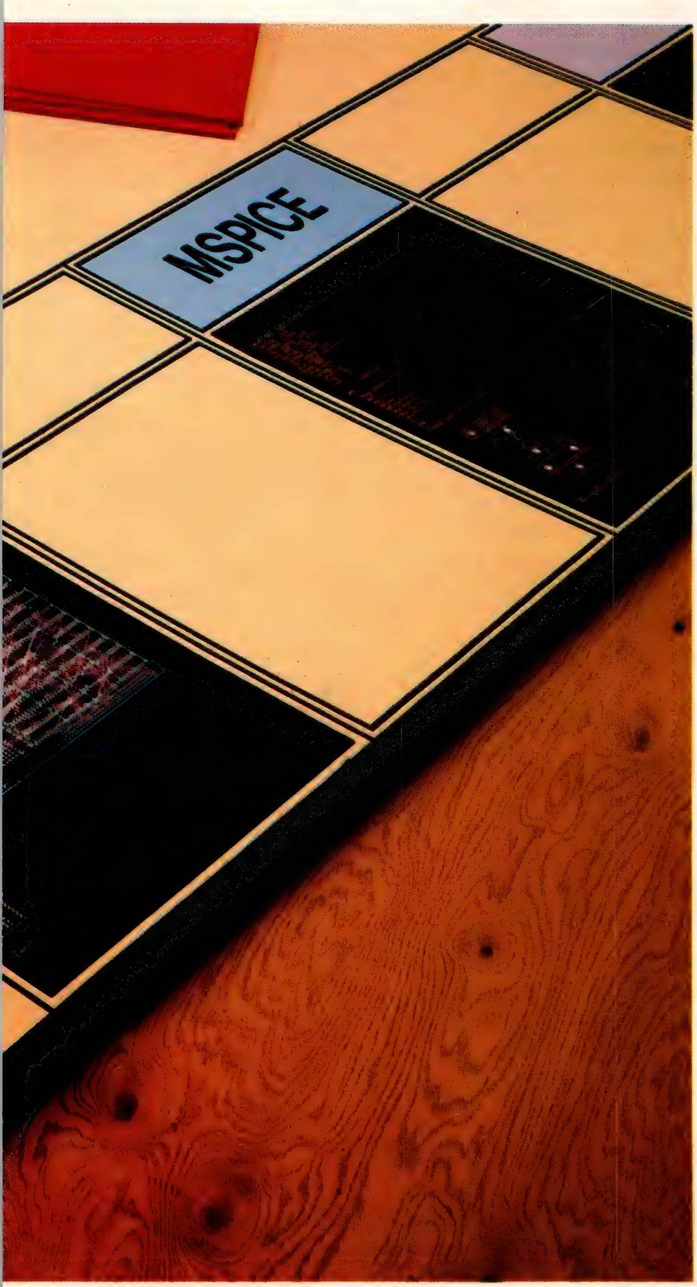
If you employ so-called "point" accelerators to boost the throughput of a CAE system, you're winning the battle but losing the war.

Why? Consider a design cycle where logic simulation accounts for 50% of total cycle time. Even if you accelerate the simulation phase by 1,000,000X, you realize only a 2X gain in total design throughput.

Which makes point accelerators a dubious investment, at best.

The solution? A single "global" accelerator for each and every compute-intensive phase in the electronic design cycle. By applying acceleration across the board, you get 4 to 5 times better design throughput than with the fastest point accelerator, for almost any design project.



Oddly enough, only one CAE vendor had the technological foresight to see the global approach as the ultimate solution to CAE acceleration.

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SIGNALS & NOISE

Check regulations when you choose power supplies

Dear Editor:

Several serious miscues with regard to regulations for power supplies are present in Chris Everett's Special Report on switching power supplies (EDN, April 17, pg 130).

First, in Germany, Equipment Safety Laws state that "Technical equipment may only be marketed or exhibited if it is in compliance with the generally accepted rules of technology." Actual certification is not required in most cases. The Industrial Surveillance Office can prohibit the marketing or exhibiting of noncompliant products. The impetus for German certification is usually market-driven—the customer may demand certification as evidence of compliance, or the wholesalers or retailers may require certification for their own liability protection.

In the US, not all power supplies must meet the requirements of UL1012, a standard for general-purpose power supplies. Component power supplies can be UL recognized or UL listed under many other end-product standards, including UL114 (for office machines) and UL478 (for data-processing equipment).

It's important to recognize the difference between UL-listed and UL-recognized products. UL-listed products are usually complete, enclosed end products with enclosed wiring terminations. UL-recognized products are components, including power supplies that are incomplete in some way and that may have exposed terminations. Recognized components are usually destined for installation in an end product, which may subsequently qualify for UL listing. UL-recognized components usually carry conditional limitations that must be satisfied in the end products. UL-listed products are not constrained in this manner.

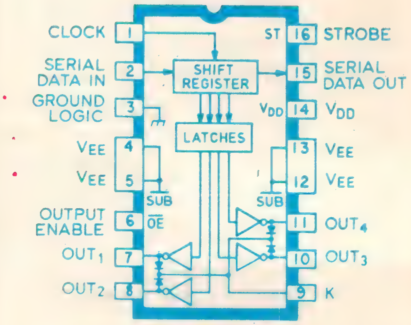
In Canada, component power supplies destined for use in office machines or data-processing equipment may be certified under CSA Bulletin 1402, which satisfies the requirements of both equipment categories. As with UL recognition, CSA certification of component power supplies may carry a list of restrictions with respect to the final application of the supplies.

"MAINTENANCE ACCESS HAS BEEN SIMPLIFIED."

The three agencies (UL, CSA, and VDE) mentioned in the article as examples of organizations that determine the salability of products within certain regions do not provide that function. The agencies write standards and provide test facilities. The policing of compliance takes place as follows: In the USA, fire regulations, insurance requirements, building codes, and local authorities, such as the City of Los Angeles, determine the salability of products. In Canada, provincial and territorial laws require that electronic products meet CSA standards. In Germany, the federal regulations discussed above determine the salability of electrical equipment.

With respect to Mr Everett's comments on the timing of agency approvals, I'd like to note that it's unusual for UL to test and recognize a product in six weeks. An 8-week period is considered to be great service, and the norm is 12 weeks. CSA usually takes longer because of additional procedural requirements.

SMART PIC



UCN-5826B BiMOS II HIGH-CURRENT SERIAL-INPUT LATCHED SINK DRIVER

- 2 A Open-Collector Outputs
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- Internal Thermal Shutdown
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- Copper Lead, Batwing Package
- CMOS Logic & Power Darlingtons (ULN-2068/69B) for SMART POWER

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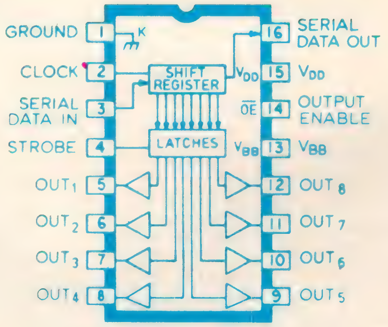

UCN-5890A BiMOS II SERIAL-INPUT LATCHED SOURCE DRIVER

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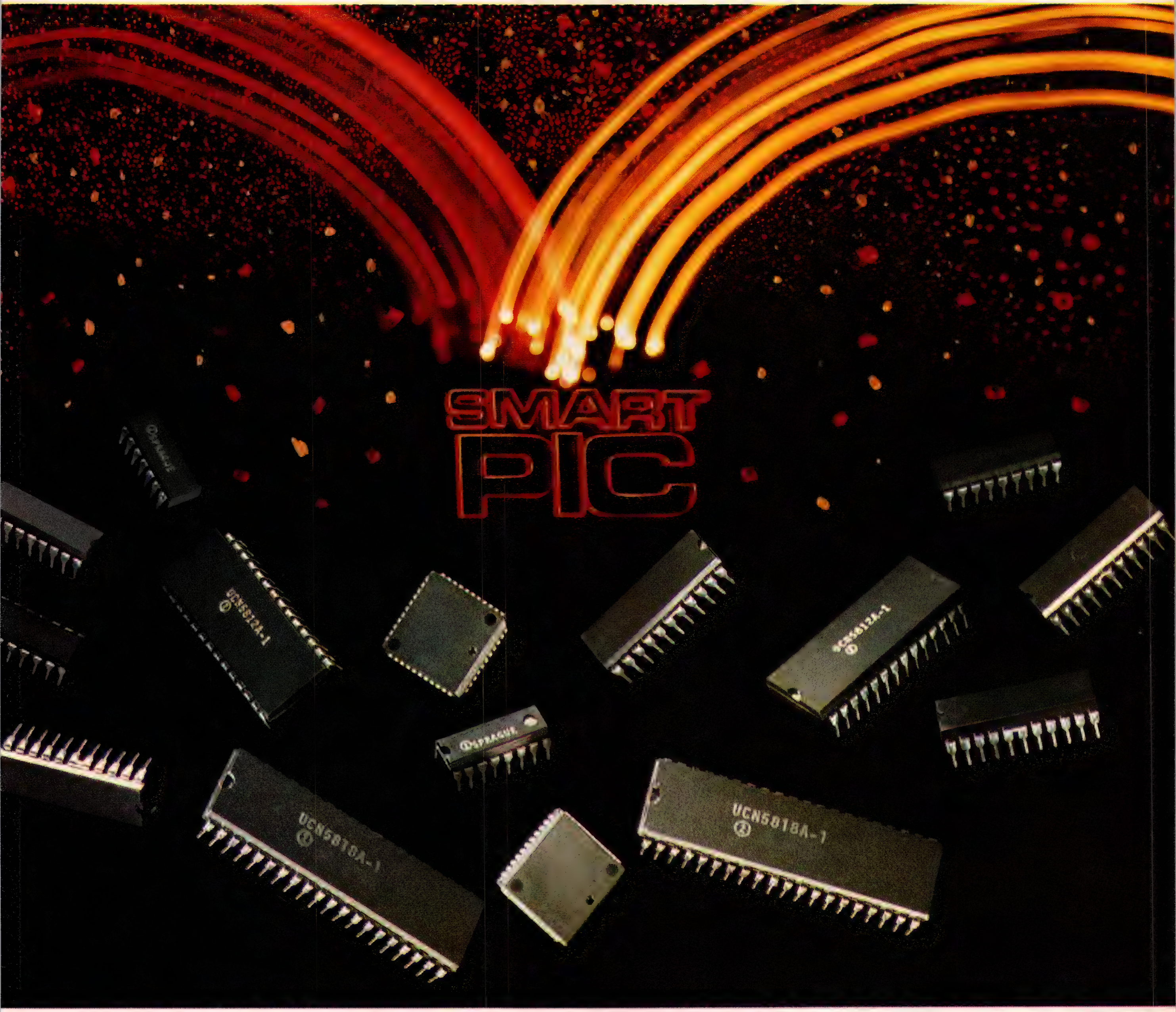

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Sprague continues its combination of bipolar power and CMOS logic in more innovative ways in its second and third generation of BiMOS power drivers (Series UCN-5800). These new devices excel in driving print heads and stepper motors as well as electroluminescent, plasma, and vacuum-fluorescent displays. They switch voltages up to 200 V, and drive loads to 2 A per channel, with up to 32 channels per chip. CMOS shift registers, latches, and decoders are incorporated for easy μP interface. Features and advantages include high input impedance, good noise immunity, wide logic supply range (5 to 12 V), and high data input rates (3 to 5 MHz).

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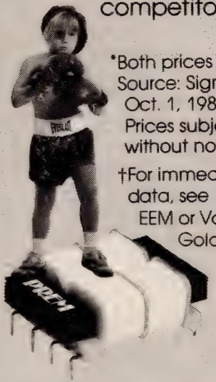
†For immediate technical data, see Vol. 1 1985/86 EEM or Vol. 2 1985/86 Goldbook



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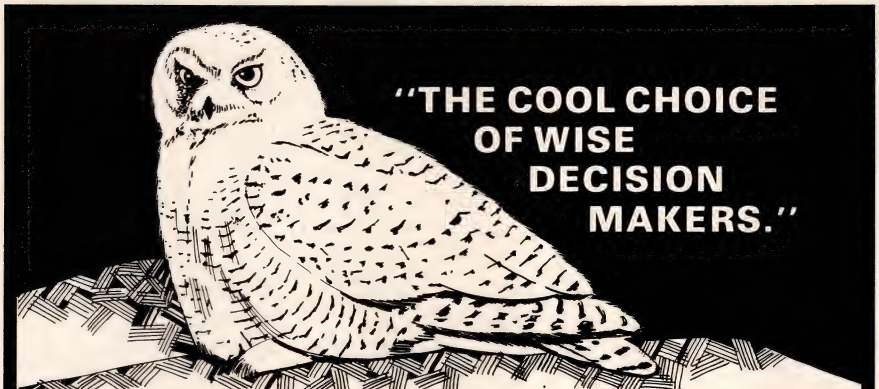
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CIRCLE NO 43

SIGNALS & NOISE

Further, readers trying to locate the TUV Rheinland testing agency will find it at 108 Millplain Rd, Danbury, CT 06811, where it moved more than a year ago. Its phone number is (203) 798-0811.

On a more positive note, I agree entirely with Mr Everett's closing comments regarding the expression "designed to meet." This terminology guarantees nothing. Caveat emptor! Valid agency file or license numbers are the chief means of verifying compliance with an agency's requirements. When you're buying a supply, don't forget to check out the agency-imposed limitations on component power supplies.

Sincerely yours,
Arthur E Michael
Director of Engineering
Power Plus
Middletown, CT

Tiny driver

The Supertex 64-channel display driver shown on pg 60 of the May 1 issue of EDN does *not* measure 65 in. on each side. It measures 0.65 in. on each side. We extend our most heartfelt apologies to those who went ahead and bought 30×14-ft circuit boards in OEM quantities.

YOUR TURN

EDN's Signals and Noise column provides a forum for readers to express their opinions on issues raised in the magazine's articles or on any topic that affects the engineering industry. Send your letters to the Signals and Noise Editor, 275 Washington St, Newton, MA 02158. We welcome all comments, pro or con. All letters must be signed, but we will withhold your name upon request. We reserve the right to edit letters for space and clarity.

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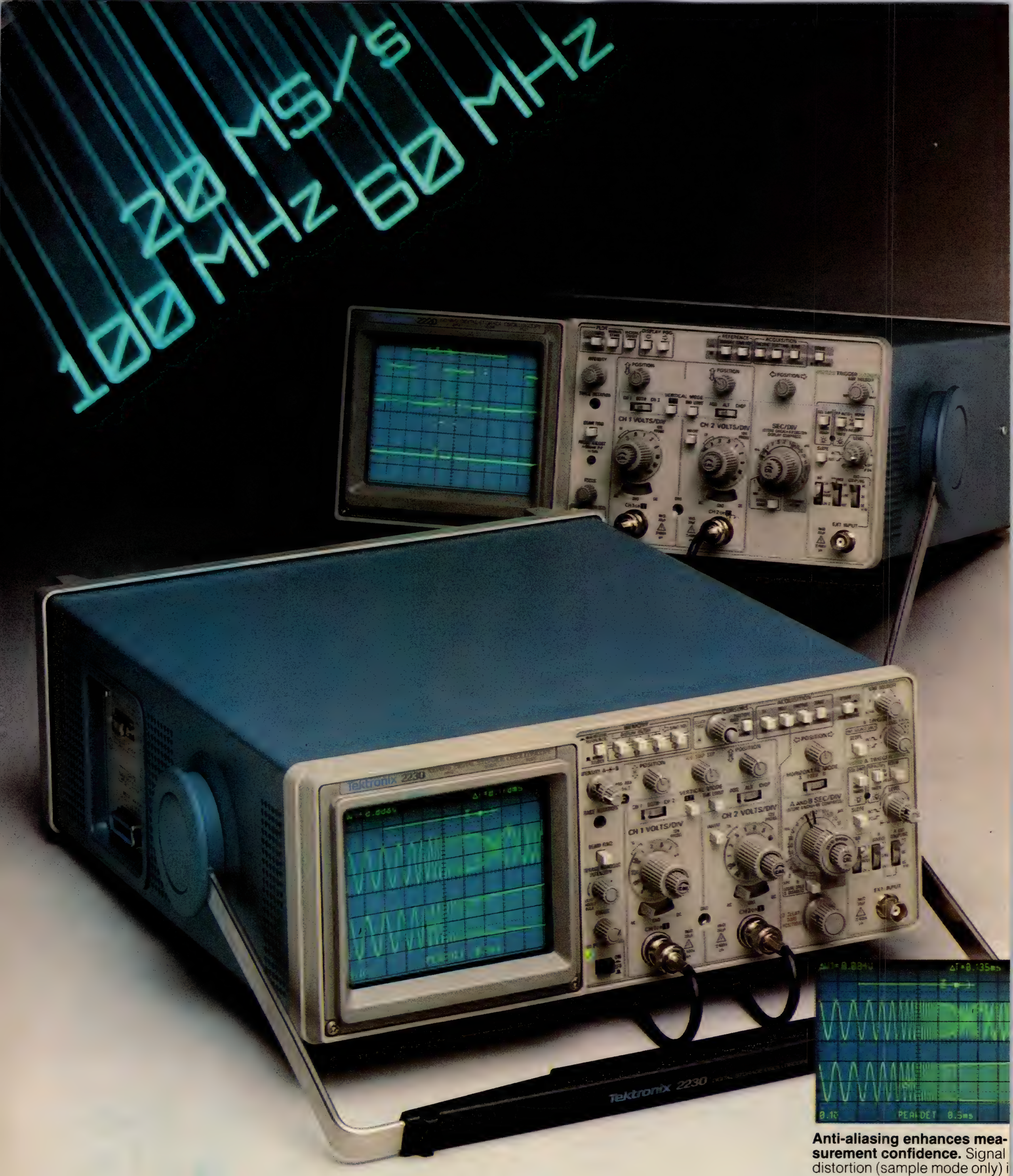

Anti-aliasing enhances measurement confidence. Signal distortion (sample mode only) i shown at high frequencies (top The peak detect mode displays peak information without signal distortion (bottom).

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INTRODUCING TWO DIGITAL STORAGE SCOPES WITH SOME MIGHTY IMPRESSIVE NUMBERS.

Features	2230	2220
Analog/Digital Storage Bandwidth	100 MHz	60 MHz
Single Shot (Transient) B.W. (10 points per signal period)	2 MHz	2 MHz
Maximum Sampling Speed	20 MS/s	20 MS/s
Record Length	4K/1K (selectable)	4K
Save Reference Memory	One, 4K Three, 1K	One, 4K
Vertical Resolution	8 bit 10 bit (avg mode)	8 bit
Peak Detect	Yes (100 ns)	Yes (100 ns)
Averaging	Yes (menu-selectable)	Yes (rep. sampling)
X-Y Storage Bandwidth	100 MHz	60 MHz
GPIB/RS-232-C Options	Yes (talker/listener, includes 26K of battery-backed memory)	Yes (talker/listener)
Price	$5150	$4150

From 4K record length to 20 MS/s sampling at 100 MHz or 60 MHz...our two new scopes have just what you're looking for! The 2230 and 2220 are powerful digital storage oscilloscopes—and the first scopes in their class that include non-storage capability to these bandwidths.

You can reference, compare, and analyze waveforms with digital storage convenience, plus the confidence you get with analog measurements. Simply switch to the non-store mode to view the signal that the scope has digitized. Only Tek offers this flexibility to 100 MHz and 60 MHz in affordable scopes.

Enhancing use of the scopes as design and troubleshooting tools are fast sample and hold detector circuits, plus the proprietary peak detect mode. They enable the display of pulses as narrow as 100 ns at any sweep speed—even on a single sweep.

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Best of all, the 2220 and 2230 are easy to use and afford. And backed by Tek's famous 3-year warranty that includes the CRT. Check the front panels. The controls are familiar, comfortable, easy to identify. Designed to push productivity and minimize training time.

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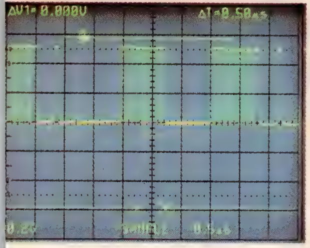

n-screen viewability lets you
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vaveforms saved in reference
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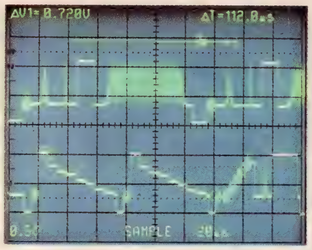
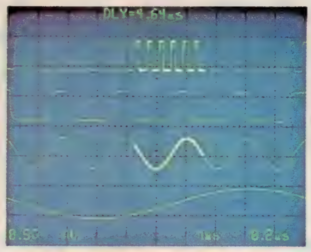
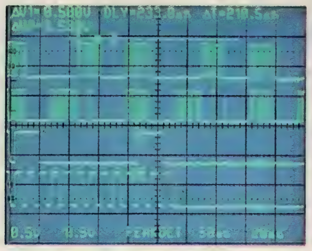
ng and display flexibility of up
o eight saved waveforms.



High display resolution and accuracy permits on-screen viewing of signals such as the TV test signal shown here. 4K of record information can be viewed in 1K windows.



100 MHz, non-storage capability comes standard in the 2230. In addition, there's dual channel, dual timebase, versatile triggering and CRT readout.



The 2230 offers the convenience of CRT readout in both storage and non-storage modes at 100 MHz. Storage mode cursors make ΔV, ΔT, and 1/ΔT measurements fast and easy.

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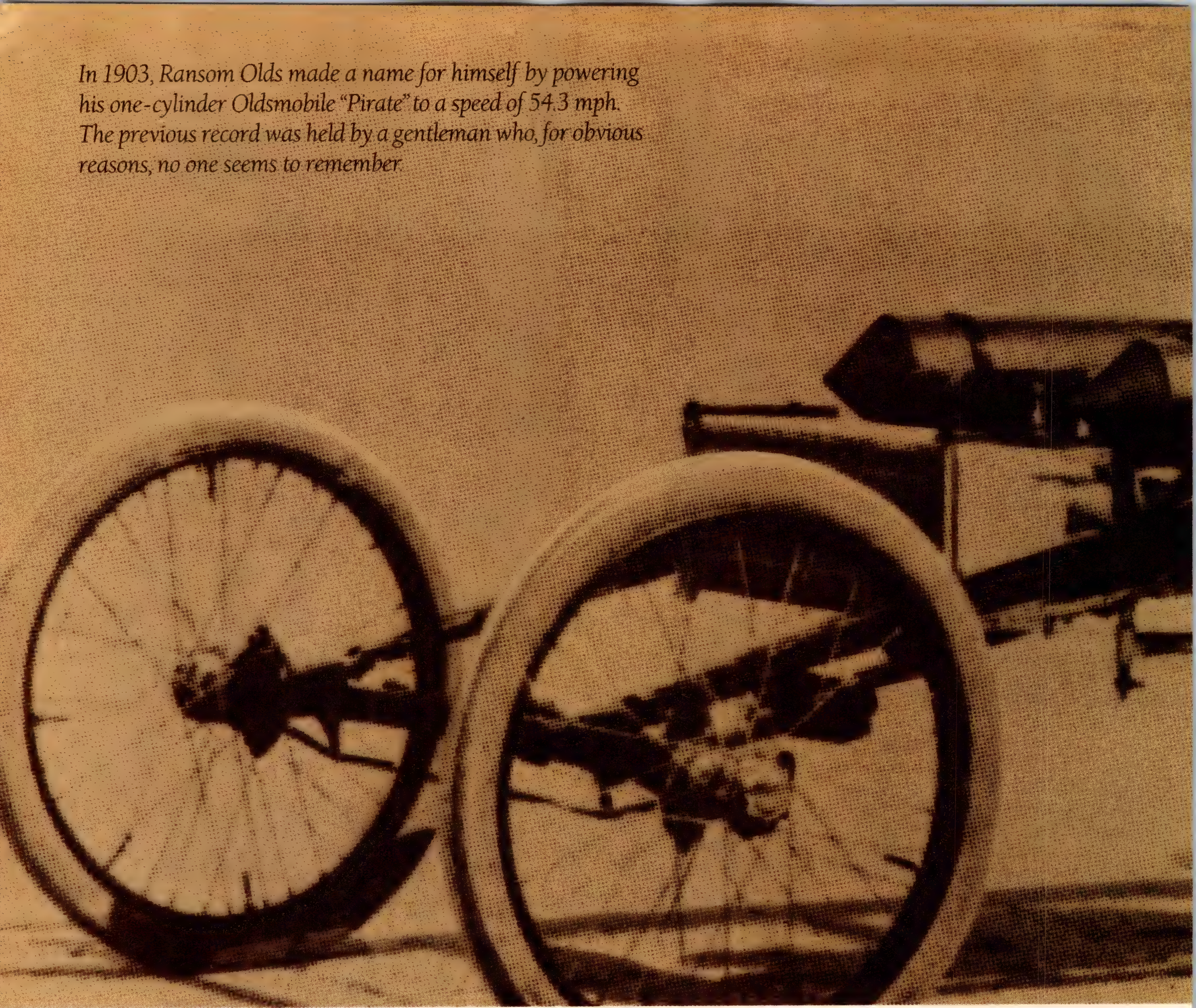

In 1903, Ransom Olds made a name for himself by powering his one-cylinder Oldsmobile "Pirate" to a speed of 54.3 mph. The previous record was held by a gentleman who, for obvious reasons, no one seems to remember.

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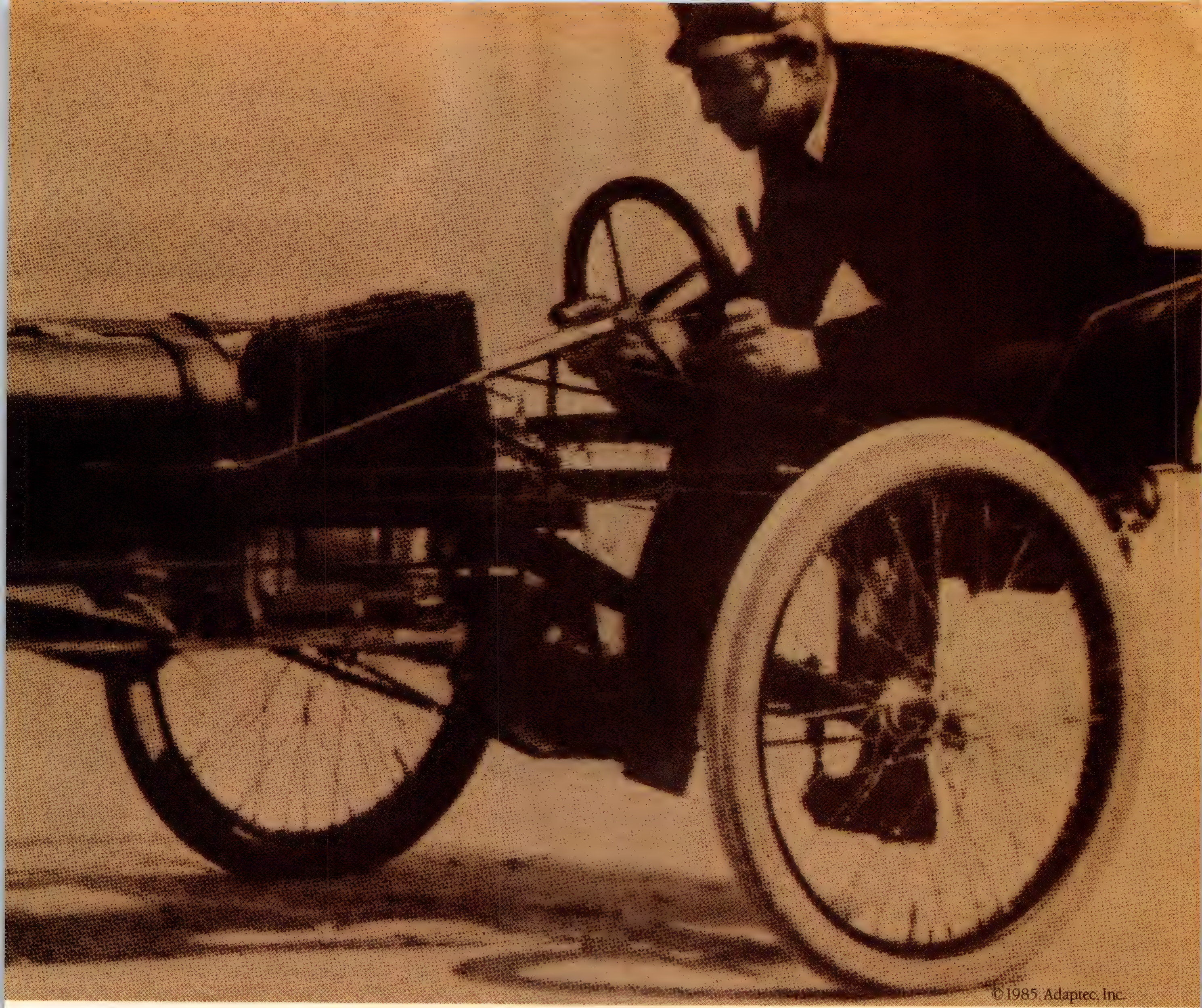

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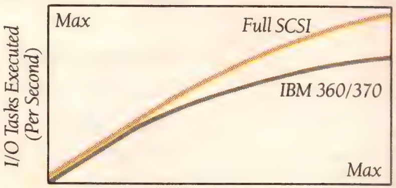

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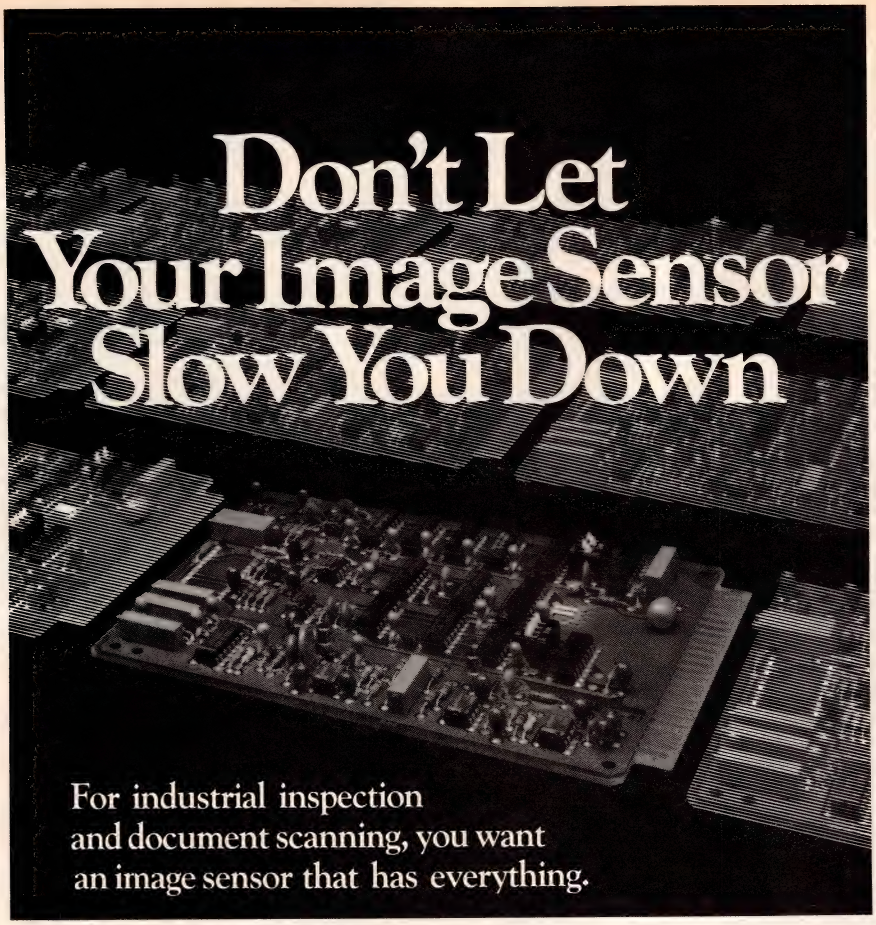
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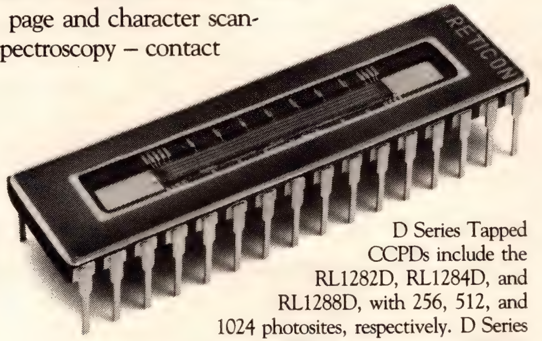

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Introduction to Local Area Networks, Washington, DC. George Washington University, Continuing Engineering Education, Washington, DC 20052. (800) 424-9773; in DC, (202) 676-6106. July 21 to 22.

23rd Annual Conference on Nuclear and Space Radiation Effects, Providence, RI. David Bushmire, Publicity Chairman, Sandia National Laboratories, Organization 2151, Albuquerque, NM 87185. (505) 844-6572. July 21 to 23.

Inter-Noise '86 (International Conference on Noise Control Engineering), Cambridge, MA. Gayle Fitzgerald, Office of Special Events, Massachusetts Institute of Technology, Room 7-111, Cambridge, MA 02139. July 21 to 23.

Principles of RF and Microwave Circuits: Theory and Applications (short course), Santa Clara, CA. Besser Associates, 3975 E Bayshore Rd, Palo Alto, CA 94303. (415) 969-3400. July 21 to 23.

IBM PC Microcomputer Interfacing, Scientific Instrument Automation, and Control, Washington, DC. Center for Continuing Education, Virginia Tech, Blacksburg, VA 24061. (703) 961-5182. July 24 to 26.

Summer Computer Simulation Conference, Reno, NV. Society for Computer Simulation, Box 17900, San Diego, CA 92117. (619) 277-3888. July 28 to 30.

International Tesla Symposium, Colorado Springs, CO. IEEE Pikes Peak Section, Box 150, Colorado Springs, CO 80901. July 30 to August 3.

SIMS '86 (Symposium for Innovation in Measurement Science), Geneva, NY. Instrument Society of America, 67 Alexander Dr, Research Triangle Park, NC 27709. (919) 549-8411. August 3 to 8.

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CIRCLE NO 139

tube•ology

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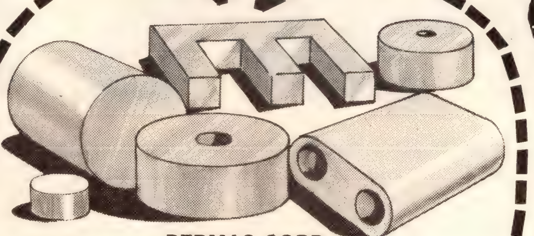

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CALENDAR

PC Fab Expo, Boston, MA. PC Fab Expo, 1790 Hembree Rd, Alpharetta, GA 30201. (404) 475-1818. August 11 to 13.

Modern Power Conversion Design Techniques (short course), Seattle, WA. E/J Bloom Associates, 115 Duran Dr, San Rafael, CA 94903. (415) 492-8443. August 11 to 15.

Siggraph '86 (13th Annual Conference on Computer Graphics and Interactive Techniques), Dallas, TX. Smith, Bucklin & Associates, 111 E Wacker Dr, Chicago, IL 60601. (312) 644-6610. August 18 to 22.

3rd International Congress on Advances in Nonimpact Printing Technologies, San Francisco, CA. Society of Photographic Scientists and Engineers, 7003 Kilworth Lane, Springfield, VA 22151. (703) 642-9090. August 25 to 28.

8th Quartz Devices Conference, Kansas City, MO. Electronic Industries Association, Components Group, 2001 Eye St NW, Washington, DC 20006. (202) 457-4930. August 26 to 28.

Advanced Database Symposium, Tokyo, Japan. Information Processing Society of Japan, Kikaishinkou Kaikan, 3-5-8 Shiba Park, Minatoku, Tokyo 105, Japan. August 29 to 30.

World Computer Congress, International Federation for Information Processing (IFIP '86), Dublin, Ireland. David Hyatt, Data Decisions, 20 Brace Rd, Cherry Hill, NJ 08034. (609) 429-7100. September 1 to 5.

Comdex/Australia, Sydney, Australia. Interface Group, 300 First Avenue, Needham, MA 02194. (617) 449-6600. September 2 to 5.

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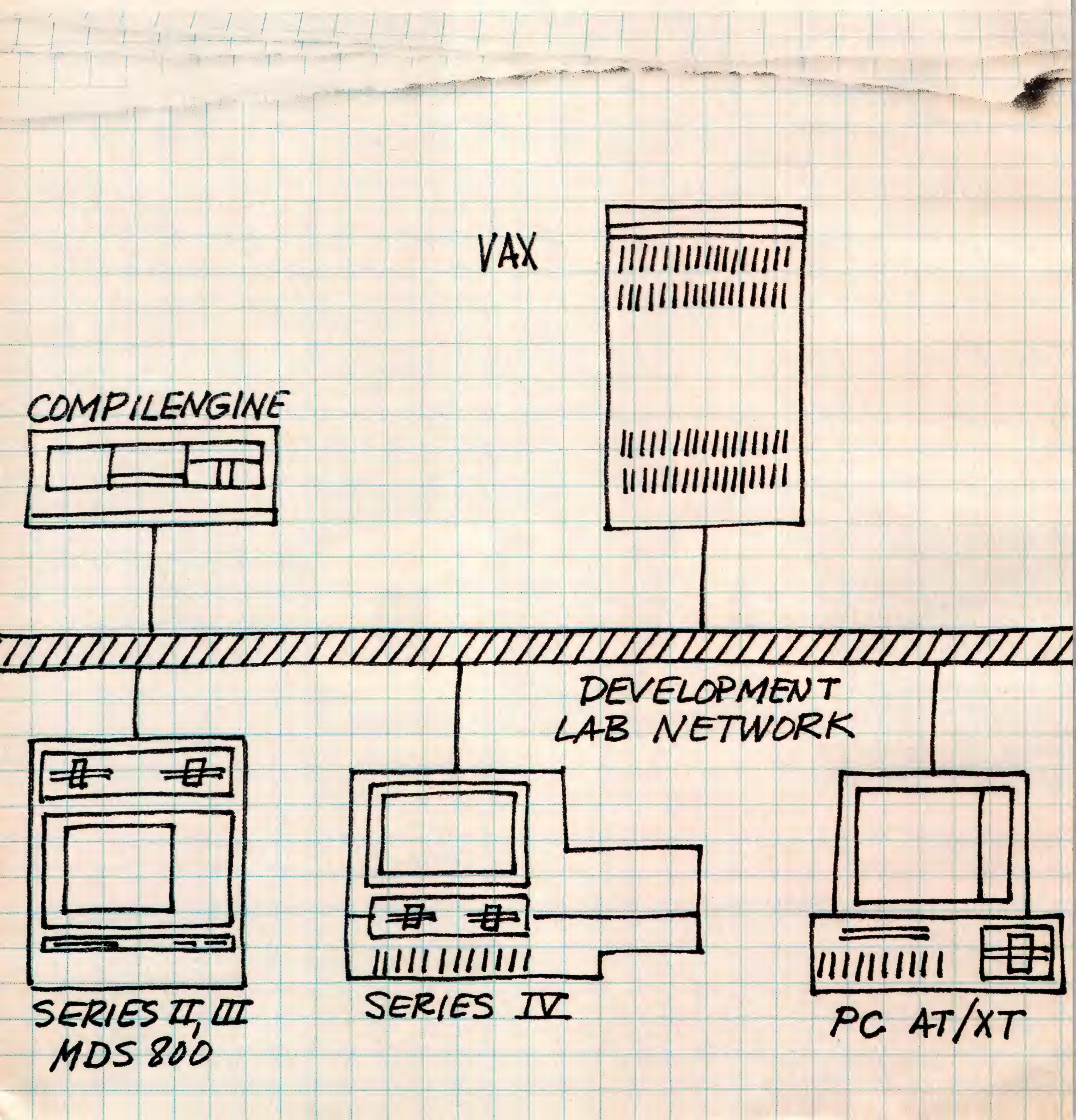

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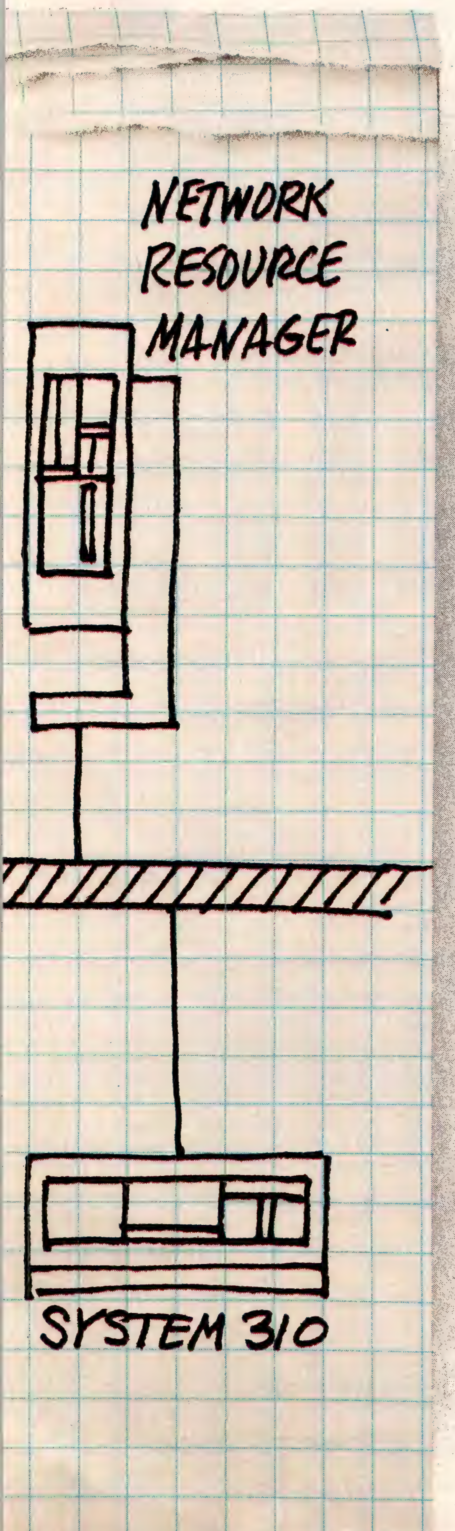

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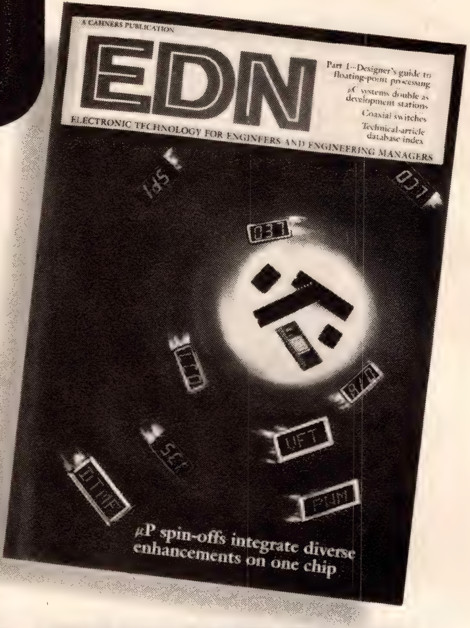
HOW TO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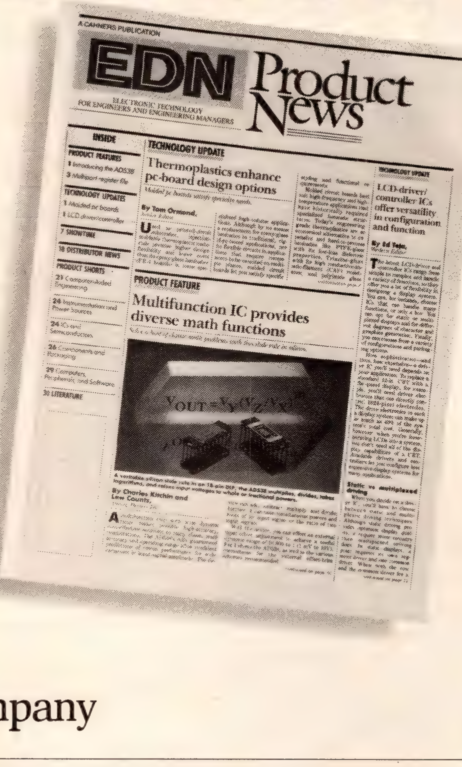
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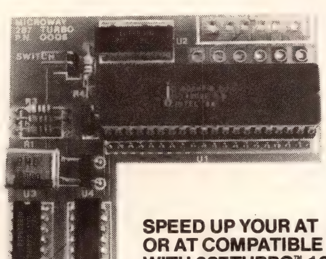

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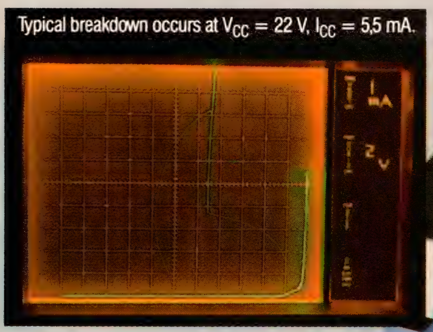
CIRCLE NO 187

The all-important high-speed CMOS question. Will latch-up cause burn-out?

With Philips high-speed CMOS (HCMOS) logic ICs, the answer's no. Because they're free from latch-up.

What causes latch-up?
Latch-up occurs when SCRs (formed by parasitic bipolar transistors found in all CMOS structures) are triggered by current transients arising from over-voltage at the input, output or supply pins, or by ringing on the signal pins. The resulting short-circuit across the supply rails causes excessive current and inevitably destructive power dissipation.

Typical breakdown occurs at V_{CC} = 22 V, I_{CC} = 5,5 mA.



Curve tracer display from latch-up test with excess supply voltage. At no time did latch-up occur in the Philips HCMOS IC, since the supply voltage snaps back to 13 V.

How is it overcome?
We prevent any current injection into the SCR structures by growing an epitaxial layer on a very low-resistivity substrate. And by using unique design and process parameters to minimize the gain of the parasitic transistors, we achieved complete latch-up immunity. No burn-out.

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Even in noisy, high-temperature environments such as automotive and industrial applications, Philips HCMOS logic goes on working. And you get exceptional noise immunity because the input switching levels of 74HC/HCU circuits are 30% and 70% of the supply voltage. Moreover, the whole Philips 74HC/HCT/HCU family has a standard temperature range from −40 to +125 °C.

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RCA is an alternate source for Philips HCMOS ICs.

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CIRCLE NO 13

Engineering organizations that emphasize social concerns deserve your support

One stereotype of engineers portrays them as fascinated with technology and gadgets to the exclusion of other concerns, including the effects of their profession on other people. But countering this stereotype is the emergence of organizations that help engineers deal with the broader nature of their labors (see "As engineers' social conciousness matures, concerned groups act as the guiding light," pg 293).

Such organizations, which range from the IEEE's Society on Social Implications of Technology (SSIT) to the High Technology Professionals for Peace (HTPFP), fall into two categories:

- Groups like the SSIT can encourage the use of technological expertise to help answer complex social or political questions.
- Groups like HTPFP can help individuals reconcile their careers with their personal beliefs.

The first of these two categories is increasingly important in light of the complexity of the systems—intelligence, defense, etc—that today's politicians must decide whether to build. The IEEE-sponsored Electro/86 session entitled "The Strategic Defense Initiative in Perspective," which featured papers supporting both sides of the SDI argument, is one example of how these groups can attempt to bring technical expertise to bear on political decisions. As another example, The Computer Professionals for Social Responsibility has cosponsored debates on SDI, focusing on the technical feasibility of proposed space-based defense systems, and it plans to become involved in civil-liberties and privacy issues arising from the rapid advances in computer and communications technology.

Once an individual reaches a personal decision about what kind of work is worth doing, he or she can turn to groups in the second category for help in attaining professional goals that don't conflict with the personal ones. HTPFP is one such organization; it strives to help job seekers determine the applications of a prospective employer's products.

In any field, specialists must take responsibility for the results of their work. As SSIT's chairman Stephen Unger puts it, "It's important that engineers . . . not behave as hired hacks." Those who do, he notes, are exhibiting "an unprofessional attitude . . . one that's potentially disastrous to society." Any group that can help you contribute to intelligent decisions regarding complex technology, that can help you intelligently shape your own opinions, or that can help you fulfill your career goals without compromising your beliefs deserves your support.

Rick Nelson

Rick Nelson
Managing Editor

WEEK 40

At last there's a microprocessor that's an arch conservative when it comes to power issues and a flaming liberal when it comes to high performance: AMD's Am29C117 16-bit CMOS Microprocessor. It's fast, but it only uses a frugal 25% of the power of the bipolar Am29117.

Am29C117

Cross party lines.

Get ready to save a lot of time if you're designing a pipeline system. The Am29C117 has two separate I/O ports for simplified timing, so you can achieve up to a 15% increase in throughput on a system basis over an Am29C116. A 16-bit barrel shifter allows you to shift or rotate a word up to 15 positions in a single instruction cycle.

That means you don't have to worry about extra parts or using valuable board space. It's plug compatible with the Am29117 and uses the same instruction set.

It has a 125ns microcycle time. Or an 8mHz data rate.

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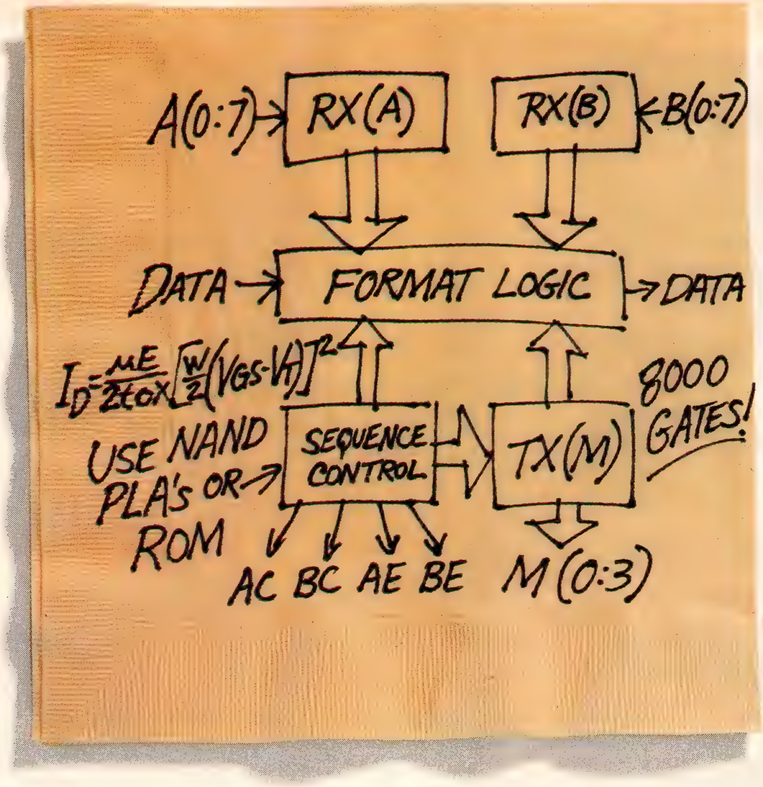

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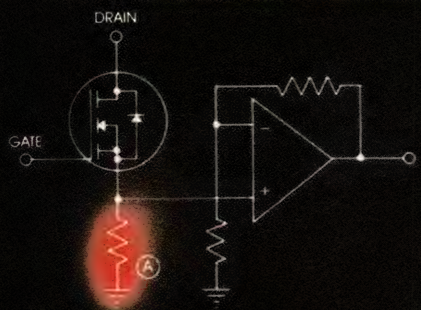
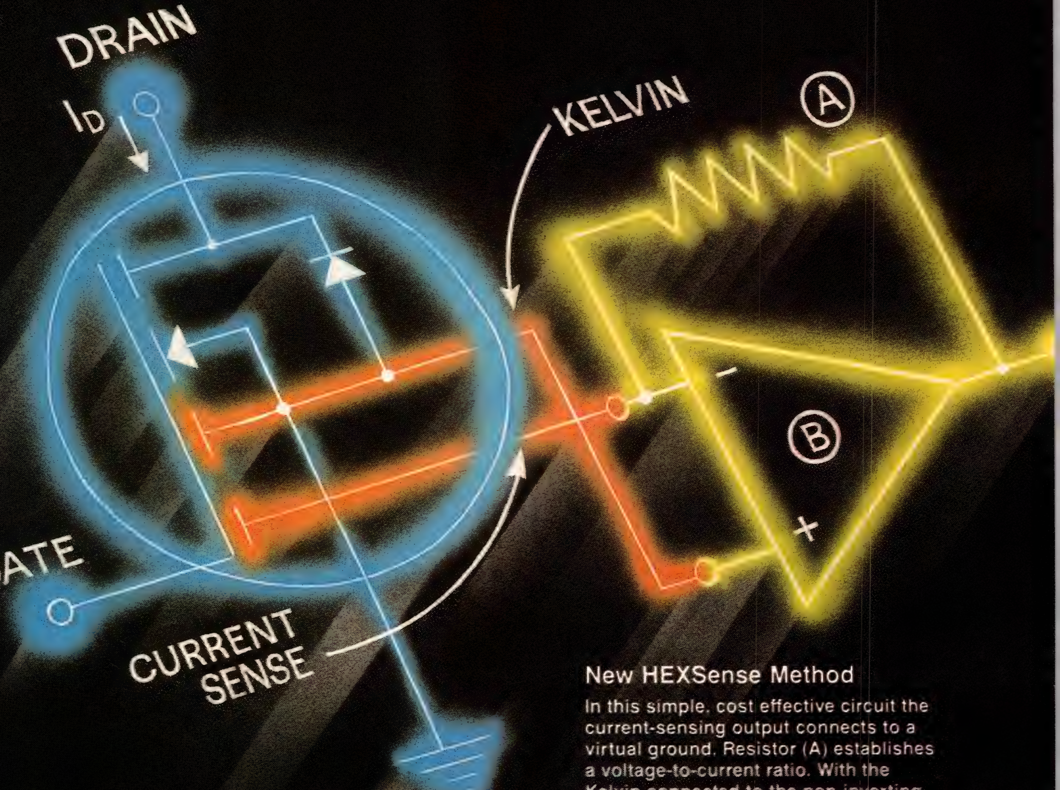


Old Method

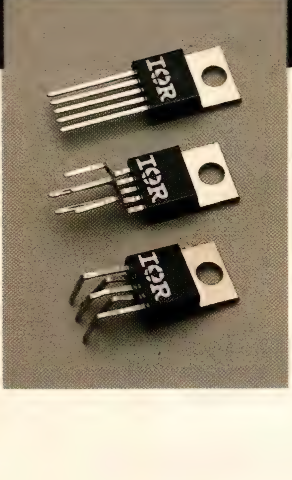
This circuit uses a fractional value resistor (A) to measure current, causing a voltage drop which increases power losses. Its parasitic inductance also slows down switching speed. To offset these losses, a lower $R_{DS(ON)}$ power MOSFET may be used, increasing circuit cost.



New HEXSense Method

In this simple, cost effective circuit the current-sensing output connects to a virtual ground. Resistor (A) establishes a voltage-to-current ratio. With the Kelvin connected to the non-inverting input of (B), a highly accurate current-sense results.

HEXSense offers 5-pin lead forms for vertical and horizontal pcb mounting.



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QIC-120 tape drive stores 125M bytes, comes in a half-height 5¼-in. package

Users of ¼-in. cartridge tape drives can now obtain a 125M-byte model, the 5125E. The basic QIC-120 drive fits into a half-height 5¼-in. package; with a controller board, it fits into a full-height space. The drive's brushless dc motor consumes less than 50% of the power that earlier drives required.

The QIC-120 spec (from the Working Group for Quarter Inch Cartridge Drive Compatibility) defines a format based on 15 serpentine tracks instead of the nine tracks in the QIC-24 format. The QIC-120 spec provides for 10,000-bpi data density; in contrast, QIC-24 drives provide for 8000 bpi. QIC-120 drives spec a 72-ips tape speed, and QIC-24 drives operate at 90 ips. However, QIC-120 specs require that drives operate at 90 ips during rewind operations and when reading QIC-24 tapes.

The Model 5125E drive meets the QIC-120 spec, yet maintains downward compatibility with 60M-byte QIC-24 products, so the 5125E drive lets you upgrade the earlier ¼-in. cartridge products. The 5125E reads both QIC-120 and QIC-24 tapes, but writes only on QIC-120 tapes. The drive operates with standard 3M DC600A cartridges, but it performs best with the new DC600XTD-type cartridges.

This 125M-byte QIC-120 tape drive, *the 5125E, occupies a half-height, 5¼-in. package and provides downward compatibility with QIC-24 (60M-byte) products.*

Like most QIC drives, the 5125E employs the QIC-36 basic drive-level interface. Both QIC-120 and QIC-24 drives use this drive interface, which operates at 90k bytes/sec.

In addition to meeting the QIC standards, the 5125E offers several features that provide for data reliability and media interchange with other QIC-120 drives. (Five to 10 more manufacturers will probably introduce QIC-120 drives by the end of this year.) The drive employs a read-after-write head with a separate erase gap. The head width allows the drive to read either QIC-120 or QIC-24 tapes.

The drive also has an edge-sensing feature, which provides for correct head alignment. To ensure that the tape head is properly aligned, the drive performs a "shoeshine" operation, moving the tape over the tape head as the head moves parallel to the plane of the tape. During the shoeshine operation, the drive continually tries to write and read data. The drive senses the edge when the heads first write and read successfully.

During its operation, the 5125E also employs an off-track sensing scheme, which allows the drive to make small adjustments in head position when read signals are weak.

The 5125E drive comes with a QIC-36 basic interface. You can also choose a QIC-02, SCSI, or IBM PC interface board. The basic 5125E drive costs $495 (1000). Samples will be available by the end of July, and production quantities will be available by the beginning of the fourth quarter.—***Maury Wright***

Wangtek, 41 W Moreland Rd, Simi Valley, CA 93065. Phone (805) 583-5255.

Circle No 744

T1 interface combines analog transmit and receive functions in one 28-pin 5V IC

Providing a single-chip solution to your analog T1 line-interface problems, the CSC61544 combines data transmission and reception in a 28-pin CMOS device. This IC features a programmable, pulse-shaping line driver that gives you µP-based interface control. Similar devices from other manufacturers often rely upon external RC circuits to achieve final pulse shaping.

The CSC61544 operates from a single 5V supply and dissipates a maximum of 500 mW. As a transmitter, the device takes data from a T1 terminal and produces alternate bipolar pulses of appropriate shape according to telephone-company specifications. For accurate pulse shaping, you can select different line lengths from as many as five distances ranging from 0 to 655 ft. The B8ZS-Select feature lets you insert B8ZS coding into the data stream.

You can use a single 28-pin IC as a T1 line interface. *The CSC61544 T1 line interface provides µP-based control of transceiver interfaces that previously required external circuits for pulse shaping.*

The transmitter also employs a crystal-controlled jitter attenuator, which comprises a 16-bit elastic store and a phase-lock loop (PLL). This attenuator removes as many as 14 unit intervals of jitter (p-p) from outgoing data. The PLL is immune to false-lock problems at harmonic frequencies.

The CSC61544's receiver circuit extracts data and clock signals from an AMI (alternate mark inversion) coded signal, and it transmits these signals as synchronized data. The receiver can also reinsert zeros that had been transmitted as B8ZS bipolar violations. Further, the receiver requires no external equalization circuits or automatic-line-build-out (ALBO) circuits.

The IC also provides a data/timing recovery feature, a driver-performance monitor, a loss-of-signal indicator, a bipolar-violation indicator, and two loopback modes. The local loopback mode bypasses the transmit and receive circuits, thus routing clock and data transmission signals to the IC's clock and data reception pins. The remote loopback mode sends clock and data input signals back to the line via the IC's driver and the elastic store.

The CSC61544 performs pulse shaping with a digitally controlled S/H array and a slew-limited amp. The device can also transmit or receive all ones. The IC is transparent to the T1 framing format, and it can work with a variety of cables. You can order the CSC61544 as a plastic DIP or in a plastic leaded chip carrier. Prices range from $23 (1000).

—J D Mosley

Crystal Semiconductor Corp,
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Circle No 741

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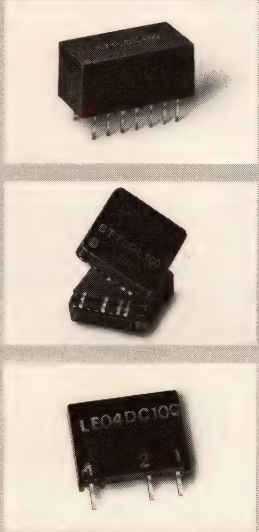

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CIRCLE NO 120

Power-MOSFET sense terminal allows no-loss load sensing

Two power MOSFETs incorporate built-in current-sensing circuitry that provides practically lossless source-current sensing. The IRC530 and IRC830 HexSense devices, the first two members of a planned family of devices, come in 5-terminal TO-220 packages. **Fig 1** shows the schematic symbol the manufacturer proposes for the units.

The current emanating from the sense terminal is a small portion of the current flowing in the power-source lead. For the IRC530, the power/sense-current ratio is 1658±2.5%; for the IRC830, the ratio is 1569±2.5%. Drain-source voltage is rated at 100 and 500V for the IRC530 and -830, respectively. The current rating for the IRC530 is 14A, and its $R_{DS(ON)}$ is 0.18Ω. For the IRC830, the corresponding specs are 4.5A and 1.5Ω.

The sense circuitry comprises a small number of HexFET cells, which are isolated from the main source metallization. A separate bonding wire connects these cells to the TO-220 package's sense terminal. Because the sense cells are identical to the power cells, the current in the sense cells is a scaled-down, fixed-ratio portion of the main source current. The low number of sense cells keeps the power losses in these cells to a few milliwatts.

Because the MOSFETs' bonding wires and package pins introduce resistance in the source circuit, the resulting imbalance in the ratio of the main cells' and sense cells' $R_{DS(ON)}$ values can lead to measurement errors. The Kelvin connection, made at the center of the die, allows you to compensate for the effects of the parasitic resistance in your measuring circuit. Further, the Kelvin connection lets you eliminate the effects of stray inductance in the source connection by connecting the drive signal between the gate and the Kelvin pin.

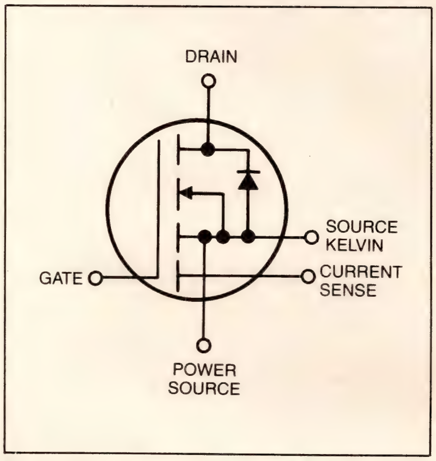

Fig 1—This proposed symbol for sense-cell power MOSFETs *shows the extra source terminal used for sensing current. The current in this source is a small, fixed-percentage portion of the current in the power-source path. The Kelvin connection allows you to eliminate errors arising from parasitic resistance and inductance in the source connection.*

These 100 and 500V devices use the manufacturer's Hex 3 die size; 50, 200, 250, and 400V MOSFETs will soon round out the Hex 3 family. In addition, the manufacturer will soon offer a family of smaller and larger units that use Hex 2 and Hex 4 dies and have the same six voltage ratings. The manufacturer will also announce 50 to 500V high-power units in TO-247 (TO-3P) packages; these MOSFETs will use dies from the Hex 3, 4, and 5 series. The IRC530 and IRC830 cost $1.60 and $1.90 (1000).—***Bill Travis***

International Rectifier Corp, 233 Kansas St, El Segundo, CA 90245. Phone (213) 772-2000.

Circle No 745

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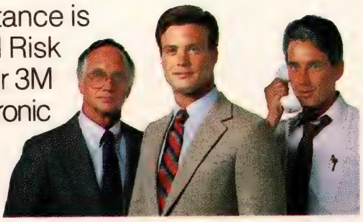

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CIRCLE NO 143

Knock-down vertical enclosures offer the strength of welded units

A line of off-the-shelf, knock-down vertical enclosures offers the strength and rigidity of welded enclosures, but is easy to assemble and can save you as much as 66% in shipping costs and 88% in storage space as compared with welded units, the manufacturer claims. The MVE cabinet derives its strength from a construction technique that interlocks both the top and bottom of the cabinet.

The enclosures are made of 13-gauge, cold rolled steel and feature an EPA-approved, textured acrylic-enamel finish. The modular construction enables one person to assemble any of the enclosures in minutes. The design also reduces replacement costs, because all cabinet components (including frame parts) are removable and interchangeable. You can install custom components in the field without replacing the entire cabinet.

Further, the manufacturer can fabricate side panels and doors with the connector openings and other cutouts that you specify. As your application requirements change, you can easily replace existing panels with custom panels.

The enclosures' strength and rigidity comes from the novel design of their corners. A heavy-gauge mounting plate is welded into the top and bottom of each corner post. This plate is recessed into the column; when the assembler tightens the corner bolt, the plate and the contact area of the cabinet frame deflect, forming a broad contact surface. The column-to-cabinet-base (or cabinet-top) joint is very rigid, therefore, because it's always preloaded in tension.

The corner joint's interlocking tab-and-slot construction also guarantees correct assembly. The corner posts are always in the proper position for side-panel and door mounting.

The MVE line includes models that are 61 and 70 in. high, 25 or 30 in. deep, and 19 in. wide. All units bolt together easily to provide multiple bays. The cabinets' removable side panels and doors provide access to the equipment inside. A blue/white finish is standard, but custom colors are available. $525 (100) for a 61×25-in. single-bay unit.

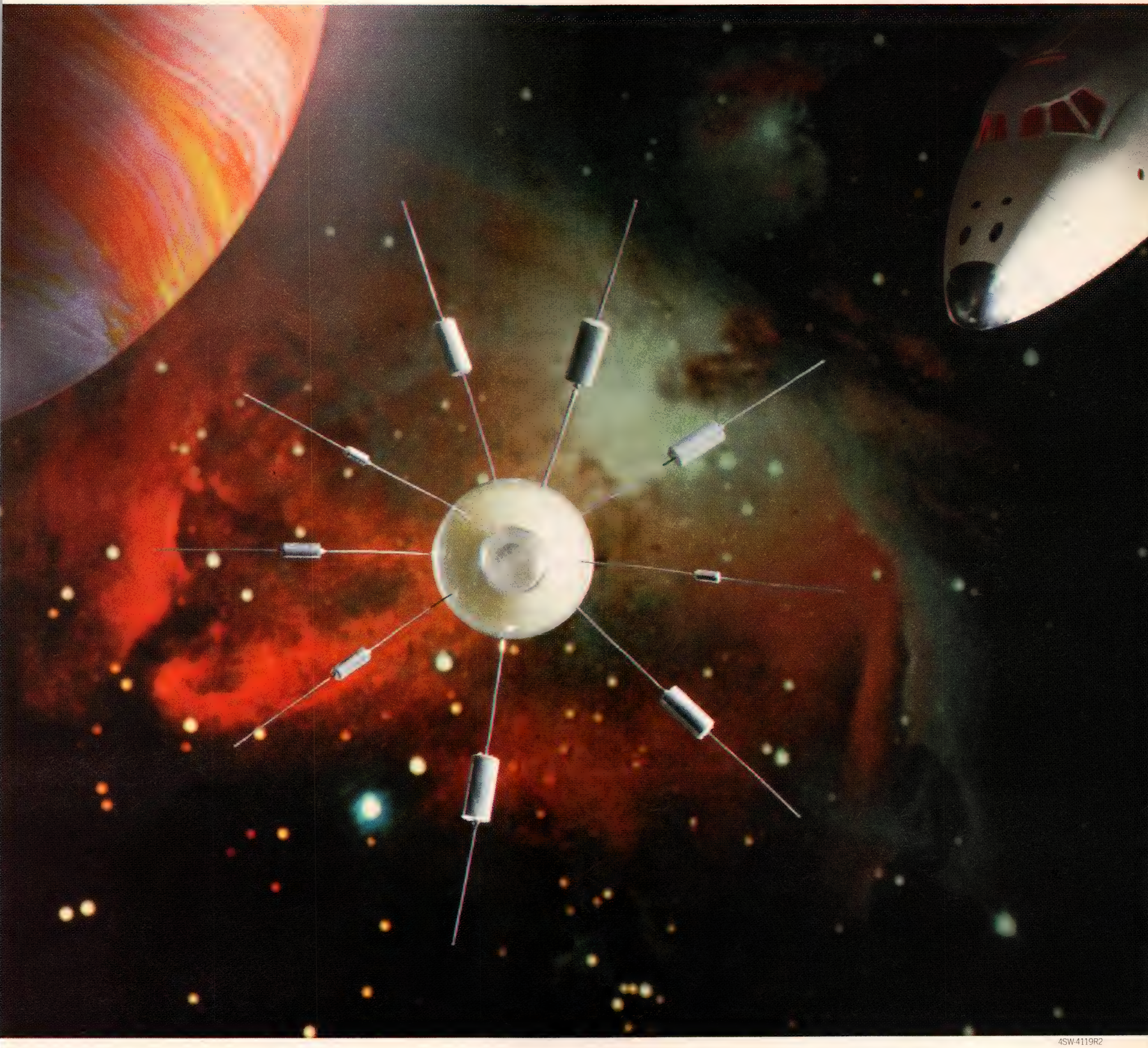
—*Tom Ormond*

CTS Metal Products, Monon Div, Hwy 16 West, Monon, IN 47959. Phone (219) 253-6666.

Circle No 742

Offering the strength of welded cabinets, *the MVE line of knock-down vertical enclosures feature a modular design that makes it possible for one person to assemble the enclosures in a matter of minutes.*

EXCELLENCE.



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4k×4-bit static RAM cuts CMOS access time to 20 nsec

The MK41H68 CMOS 4k×4-bit static RAM's 20-nsec address-access and read-cycle times compare favorably with the 35-nsec access time of the Motorola MCM6168HP35, the 30-nsec spec of Intel's 51C68-30, or the 25-nsec spec of the Cypress CY7C168. Fabricated in a full-CMOS double-level-metal process, the MK41H68 derives its speed from its 1.2-μm drawn channels, which provide submicron effective-channel lengths.

Protected against static discharge by its low-capacitance TTL-compatible inputs and outputs, the MK41H68 features fully static operation—the IC requires no external clocks or timing strobes. A Chip Enable ($\overline{CE}$) power-down feature automatically reduces power dissipation when the $\overline{CE}$ line becomes inactive.

To power the chip, you need only a single 5V power source. However, the manufacturer recommends that when you design your circuit, you place a high-frequency decoupling capacitor of at least 0.1 μF next to each RAM.

You can order specialized versions of this 4k×4 CMOS static RAM. The MK41H69, for instance, replaces the $\overline{CE}$ power-down line with a 10-nsec Chip Select ($\overline{CS}$) line, which is faster than the 20-nsec ($\overline{CE}$) line. By eliminating the power-down mode, the $\overline{CS}$ provides rapid access to data in the IC's static storage array.

Two other versions, the MK41H78 and MK41H79, are similar to their MK41H68 and MK41H69 counterparts, but add an output-enable ($\overline{OE}$) line and come in 22-pin packages. The MK41H79 also provides a Flash Clear pin, which sets the device to all zeros when you clear the memory. All four ICs are also available in low-voltage TTL versions (MK41L-) that comply with the JEDEC LVTTL standard for 3.3V operation.

By combining a 20-nsec access/cycle time *with a full-CMOS double-level metal process, the MK41H68 static RAM lets you incorporate both high speed and low power in your memory applications.*

The 20-nsec MK41H68 is available for $34.30 (100). A 25-nsec version costs $21.45, and a 35-nsec version sells for $17.85 (100). Pricing for the other MK41H- and MK41L- static RAMs ranges from $17.85 to $37.75 in OEM quantities.

—J D Mosley

Thomson Components-Mostek Corp, 1310 Electronics Dr, Carrollton, TX 75006. Phone (214) 466-6000.

Circle No 743

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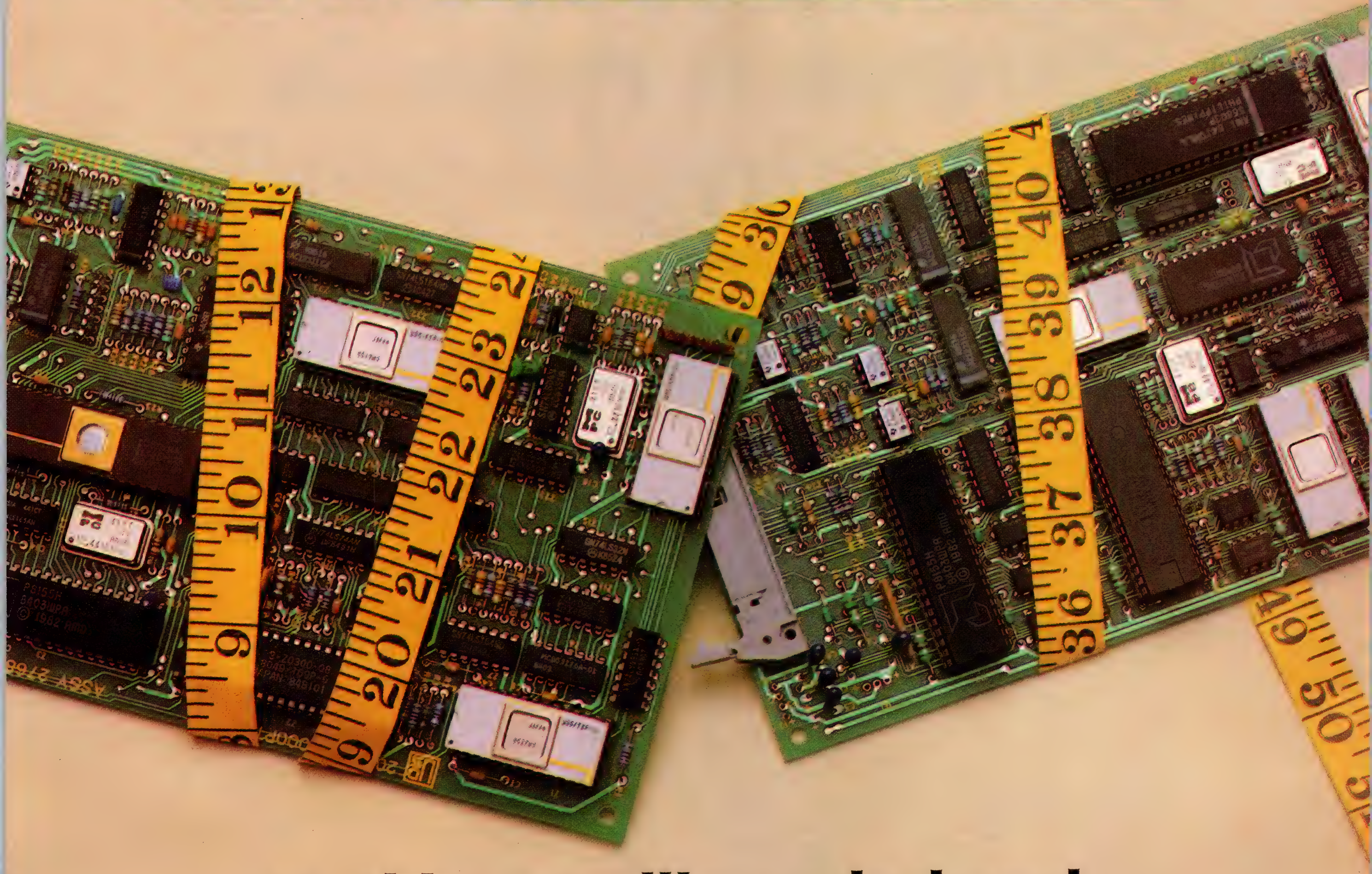

14.4kbps trellis coded and 9.6kbps modems on 40 square inches

LSI technology and UDS engineering expertise have combined to deliver two major improvements in modem design. Two of the most complex modems in the UDS product line – the fast-polling 9600FP and the Trellis Coded 14.4 – have now been reduced to 40 square inches of board space for each complete modem. To accommodate varying OEM configurations, a wide variety of form-factor layouts and option packages is available.

9600FP
This UDS modem delivers 9.6kbps speed, with only 8ms turn-around time, making it ideal for fast-poll applications. A simple strap change puts the device into V.29 configuration, which includes alternative data rates of 7200 and 4800bps.

14.4 Trellis Coded
14.4kbps (V.33) speed, merged with the signal-to-noise ratio enhancement of trellis coding, makes this modem your most cost-effective choice for moving large volumes of data over dedicated lines. It is particularly useful in applications such as complex computer graphics, where error minimization is especially critical. The device has a fallback rate of 12kbps and is strappable to V.29.

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CIRCLE NO 148

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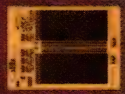

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We have a whole book full of tools you can use to build *faster, cooler* systems.

CMOS High Speed SRAM Family

Featuring the *fastest* (15ns) 4K static TTL-compatible RAMs you can buy. Plus a variety of 15ns, 25ns, 35ns, and 45ns parts, too. Nibble-wide, bit-wide, byte-wide, ranging from 64-bits through 16K-bits. Low active power. Low standby power—many parts include auto-power-down when deselected. A superset of separate I/O functions provides a design edge for improving overall performance.

CMOS High Speed PROM Family

Surpassing bipolar with one of the *fastest* registered PROMs at ½ bipolar power, or less. Parts feature speeds to 25ns set-up, 12ns clock-to-output; all with low CMOS power. Byte-wide family available in 4K, 8K, 16K, 64K densities. Available with or without registered outputs. EPROM memory technology permits 100% testing of data bits before packaging, to provide optimum programming yields, plus *windowed parts* for the convenience of reprogramming.

CMOS High Speed PLD Family

Featuring 25ns HALF-power 80 mA *windowed* 22V10 EPLD—the new high speed PAL® device standard. The family also includes QUARTER-power 45mA PAL 20 parts, and 55mA PAL 24 parts, both available at 25ns speeds and in windows. All cells 100% functionally tested. All parts with up to 75% power saving over bipolar.

CMOS High Speed Logic Family

World's fastest 4-bit-slice and 16-bit-slice microprocessors. 16 × 16 multipliers at 38ns, none faster. Plus sequencers, controllers, DSP circuits, and more. Also, fastest available 4-bit and 5-bit cascadeable FIFOs (25MHz performance).

New! Bigger! 80 high-speed, low-power parts. Yours for a phone call.
DATA BOOK HOTLINE:
1-800-952-6300.
1-800-423-4440 (In CA).
(32) 2-672-2220 (In Europe).
(416) 475-3922 (In Canada).
Ask for Dept. C76.

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SEMICONDUCTOR

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LEADTIME INDEX

Percentage of respondents

ITEM	Off the shelf	1-5 weeks	6-10 weeks	11-20 weeks	21-30 weeks	Over 30 weeks	Average (weeks)	Last month's average (weeks)
TRANSFORMERS								
Toroidal	0	50	13	37	0	0	8.0	7.9
Pot-Core	0	20	40	40	0	0	10.0	8.5
Laminate (power)	0	25	50	25	0	0	8.5	8.5
CONNECTORS								
Military panel	0	0	100	0	0	0	8.0	12.0
Flat/Cable	12	50	25	13	0	0	5.0	4.0
Multipin circular	0	33	33	34	0	0	8.7	8.0
PC	0	50	38	12	0	0	6.0	5.8
RF/Coaxial	0	25	25	50	0	0	10.5	7.1
Socket	11	34	33	22	0	0	6.9	3.4
Terminal blocks	11	56	22	11	0	0	4.7	6.1
Edge card	0	29	57	14	0	0	7.4	5.1
Subminiature	0	60	20	20	0	0	6.0	4.5
Rack & panel	0	0	50	50	0	0	12.0	6.0
Power	0	20	60	20	0	0	8.4	3.8
PRINTED CIRCUIT BOARDS								
Single-sided	0	70	30	0	0	0	3.8	3.7
Double-sided	0	7	10	83	0	0	14.2	5.4
Multilayer	0	30	60	10	0	0	7.0	7.0
Prototype	0	93	7	0	0	0	2.4	2.7
RESISTORS								
Carbon film	43	14	36	7	0	0	4.3	2.8
Carbon composition	31	23	23	23	0	0	6.0	4.4
Metal film	29	18	47	6	0	0	5.1	3.1
Metal oxide	17	17	50	16	0	0	7.0	5.2
Wirewound	20	20	40	20	0	0	6.8	5.8
Potentiometers	6	19	50	25	0	0	8.4	4.8
Networks	14	36	29	21	0	0	6.4	4.5
FUSES	25	42	33	0	0	0	3.5	3.3
SWITCHES								
Pushbutton	14	29	43	14	0	0	6.3	4.3
Rotary	13	12	50	25	0	0	8.3	4.7
Rocker	0	17	67	16	0	0	8.3	4.0
Thumbwheel	0	20	60	20	0	0	8.4	4.9
Snap action	0	25	50	25	0	0	8.5	5.2
Momentary	17	33	33	17	0	0	6.0	5.6
Dual in-line	0	25	50	25	0	0	8.5	5.7
WIRE AND CABLE								
Coaxial	14	43	43	0	0	0	4.3	2.5
Flat ribbon	18	64	18	0	0	0	2.7	2.6
Multiconductor	18	46	27	9	0	0	4.5	5.3
Hookup	47	40	13	0	0	0	1.9	1.3
Wire wrap	22	56	22	0	0	0	2.9	2.4
Power cords	7	40	47	6	0	0	5.6	4.7
Other	40	0	60	0	0	0	4.8	4.7
POWER SUPPLIES								
Switching	0	20	60	20	0	0	8.4	7.5
Linear	0	14	72	14	0	0	8.3	5.9
CIRCUIT BREAKERS	0	17	67	16	0	0	8.3	7.3
HEAT SINKS	17	42	33	8	0	0	4.8	4.4

ITEM	Off the shelf	1-5 weeks	6-10 weeks	11-20 weeks	21-30 weeks	Over 30 weeks	Average (weeks)	Last month's average (weeks)
RELAYS								
General purpose	11	11	56	22	0	0	8.2	5.2
PC board	0	14	43	43	0	0	10.6	8.7
Dry reed	0	34	33	33	0	0	8.7	6.3
Mercury	0	34	33	33	0	0	8.7	3.6
Solid state	0	29	43	28	0	0	8.6	6.8
DISCRETE SEMICONDUCTORS								
Diode	5	42	42	11	0	0	5.9	4.5
Zener	12	35	41	12	0	0	5.9	5.2
Thyristor	10	20	50	20	0	0	7.6	6.7
Small signal transistor	7	46	27	20	0	0	6.3	5.8
FET, MOS	0	28	36	36	0	0	9.3	7.2
Power, bipolar	11	22	56	11	0	0	6.7	5.5
INTEGRATED CIRCUITS, DIGITAL								
CMOS	14	7	43	36	0	0	9.3	6.2
TTL	15	15	39	31	0	0	8.3	5.6
LS	15	8	46	23	8	0	9.5	7.6
INTEGRATED CIRCUITS, LINEAR								
Communication/Circuit	0	0	50	50	0	0	12.0	6.7
OP amplifier	0	18	36	36	10	0	11.4	6.5
Voltage regulator	0	10	60	30	0	0	9.8	5.7
MEMORY CIRCUITS								
RAM 16k	0	13	50	37	0	0	10.3	6.1
RAM 64k	0	11	56	33	0	0	10.0	4.7
RAM 256k	0	13	75	12	0	0	8.3	7.5
ROM/PROM	0	0	63	37	0	0	11.0	5.5
EPROM	0	9	64	27	0	0	9.6	6.7
EEPROM	0	0	86	14	0	0	9.1	6.4
DISPLAYS								
Panel meters	0	20	40	40	0	0	10.0	7.4
Fluorescent	0	0	50	50	0	0	12.0	7.5
Incandescent	0	33	33	34	0	0	8.7	4.7
LED	8	38	31	23	0	0	6.9	4.4
Liquid crystal	0	17	50	33	0	0	9.7	7.6
MICROPROCESSOR ICs								
8-bit	0	13	50	37	0	0	10.3	6.6
16-bit	14	14	57	15	0	0	7.1	5.7
FUNCTION PACKAGES								
Amplifier	0	0	67	33	0	0	10.7	6.0
Converter, analog to digital	0	14	43	43	0	0	10.6	6.8
Converter, digital to analog	0	17	33	50	0	0	11.0	7.5
LINE FILTERS	0	40	60	0	0	0	5.6	6.7
CAPACITORS								
Ceramic	0	43	50	7	0	0	6.0	4.6
Ceramic monolithic	0	40	50	10	0	0	6.4	5.3
Ceramic disc	8	46	31	15	0	0	5.8	4.8
Film	0	36	57	7	0	0	6.4	5.6
Electrolytic	0	33	60	7	0	0	6.5	5.7
Tantalum	7	36	43	7	7	0	7.1	5.1
INDUCTORS	11	33	45	11	0	0	6.0	4.9

Source: *Electronic Purchasing* magazine's survey of buyers

Catch it . . .
Plot it!

Our PM 3305 35 MHz digital storage oscilloscope adds plot capability to 10 ns, 4-channel glitch capture. So even at a sweep speed of 5s/div, you can catch a glitch and make hard copy via an analog x-y recorder or a digital colour plotter; such as our PM 8154 or any HP-GL compatible plotter. But there's no catch to the PM 3305's many other features such as:

- **Low price.** It's the most cost-conscious DSO of its type on the market. Yet it has valuable extras like analog-to-digital conversion; X-Y display; external clock drive, and an IEEE/IEC option.
- **High performance.** It has dual-slope triggering, 4K pre-trigger ability and a selective memory expansion of up to x 40. **Single-shot event capture,** also with automatic reset for next event.

Test the difference

- **Product credibility** in technology, technique, quality and service because the PM 3305 is backed by the vast corporate resources of one of the world's largest electronics companies.

Test the difference and you'll also agree that Philips wins on price and performance!

Write to: Philips I&E, T&M Department.
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PHILIPS **Test & Measurement**

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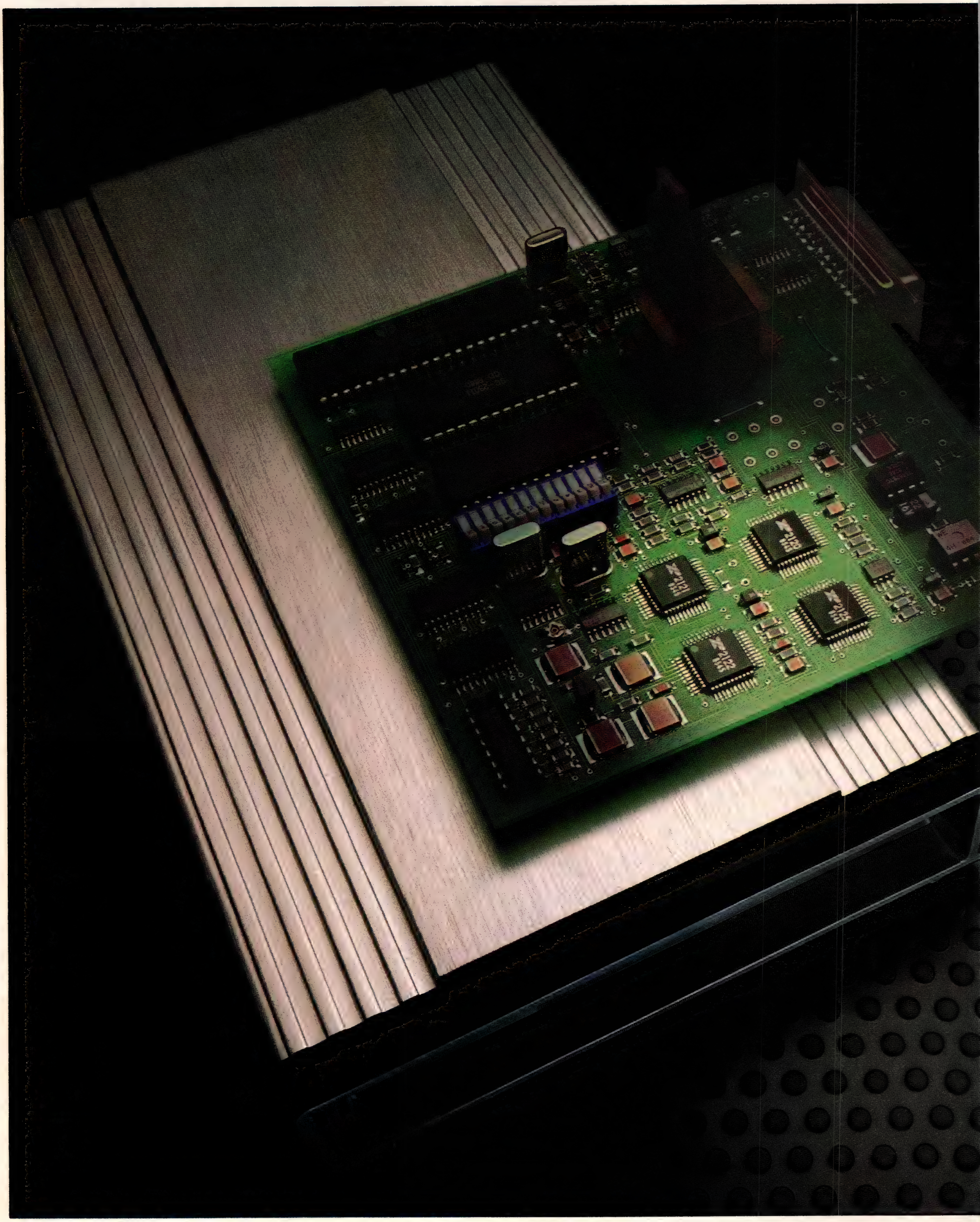
EXAR offers performance and

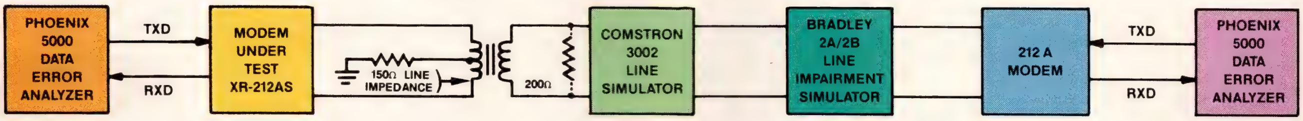


compatibility in 212A modems

Superior Performance Under All Conditions

With AT&T divesture, the likelihood of getting worst case line conditions has increased considerably. At EXAR we feel that modems must operate reliably under all the harsh conditions of the telephone network. These conditions include:

- Worst Case Line Conditions (3002, C0)
- Low Carrier Levels (−40 dBm)
- Varying Line Impedance (150 Ω)
- Frequency Offset (±5 Hz)


PHOENIX 5000 DATA ERROR ANALYZER
TXD
RXD
MODEM UNDER TEST XR-212AS
150Ω LINE IMPEDANCE
200Ω
COMSTRON 3002 LINE SIMULATOR
BRADLEY 2A/2B LINE IMPAIRMENT SIMULATOR
212 A MODEM
TXD
RXD
PHOENIX 5000 DATA ERROR ANALYZER

EXAR Performs Where Competition Fails

The XR-212AS performance under these worst case line conditions is excellent. Our modem experts could not even make the competitor's chips work under these conditions. Our lab test results show:

EXAR	COMPETITION
S/N = 12 dB BER = 1/10 −5	Non-functional

Would you want your customers to keep dialing over and over to get optimum line conditions? Don't take the chance! EXAR's chip set outperforms the competition under all conditions.

Hayes® Compatibility

EXAR offers a complete design for a Hayes® compatible Bell 212A smart modem. A complete design and software package is available to insure smooth, easy design-in for your system.

EXAR's modem experts will provide assistance during your design-in phase and will provide technical support for all aspects of your modem design. Call EXAR's responsive Applications Engineering Group on our Modem Hot Line, 408/732-7970 x 381, for modem applications assistance.

Available in SMD

The XR-212AS Bell 212A Modem Chip Set has set the standard for performance. In applications where size is of utmost importance, quad surface mount packages are now available.

Device	Function	Application
XR-2121	212A modulator	Modem Signal Processor
XR-2122	212A demodulator	
XR-2125	212A data buffer	
XR-2129	212A/V.22 filter	
XR-2120	212A filter	Modem filtering
XR-2126	212A/V.22 filter	
XR-2127	212A/V.22 filter	
XR-2128	212A/V.22 filter	

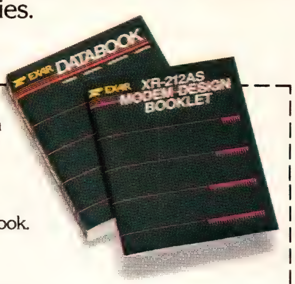
EXAR also supplies support circuits such as op amps, line drivers and receivers in a wide variety of packages including surface mount.

Value Pricing

EXAR leads the competition in performance, packaging, technical support and service and offers competitive volume pricing. That's EXAR's commitment. Contact us today for value pricing on the XR-212AS SMD quad pack modem chip set.

EXAR is an innovator in custom and semi-custom ICs, and offers one of the industry's largest lines of proprietary and alternate-sourced ICs in the standard products area used in telecommunications, digital data processing, and industrial control applications.

As well as wafer foundry services, EXAR offers custom and semi-custom programs using bipolar, CMOS (metal & silicon gate), and I²L technologies.



☐ Please send me additional information on the XR-2120/2121/2122/2125.
☐ Please send me the XR-212AS Design Booklet.
☐ Please send me EXAR's full line databook.

Name________ Title________
Company________ Dept./Div.________
Address________
City________ State________ Zip________
Phone (____) ________ Ext.________
Application________

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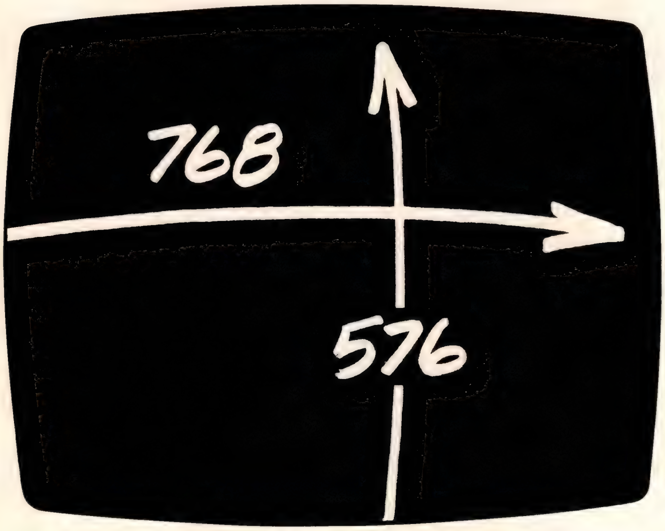
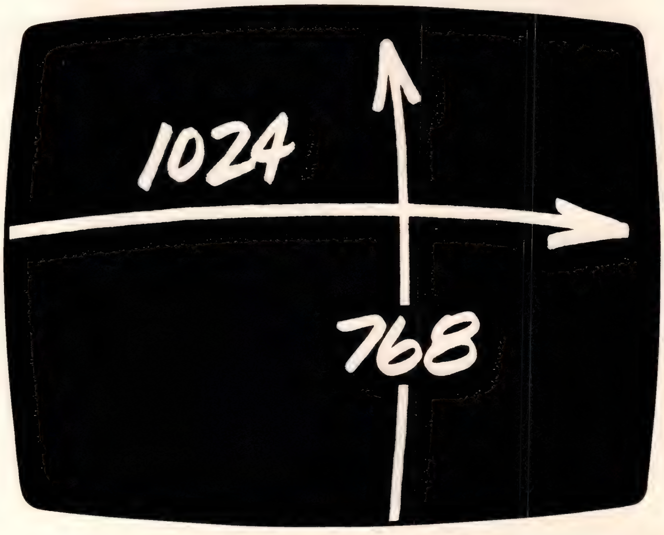
CIRCLE NO 130

Introducing four positutely



PERSONAL COMPUTER GRAPHICS



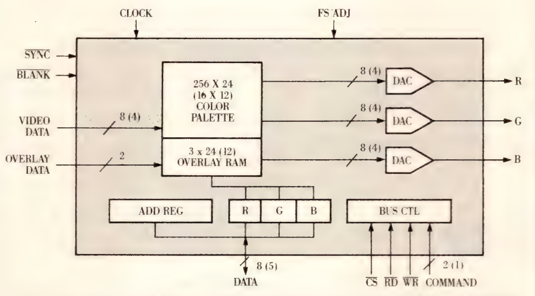
2-D ENGINEERING WORKSTATIONS

Our new family of RAMDACs is bound to make a Brooktree convert out of you.

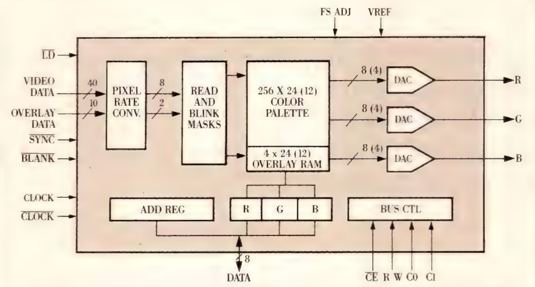
Who gives a duck's tail about RAMDACs, anyway?

Apparently, none of our competitors. None has chosen to produce more than one RAMDAC. None, we believe, has taken the time or effort to design even *one* RAMDAC the right way. The Brooktree Way.

We, on the other hand are now introducing four new RAMDACs—high performance D-to-A circuits with built-in color palettes. They make it easier than ever for you to achieve your new year's resolutions, no matter what type of graphics system you're designing. And they all take advantage of our revolutionary low-glitch architecture.



Bt453 Triple 8-bit 40 MHz RAMDAC/Bt450 Triple 4-bit 70 MHz RAMDAC



Bt458 Triple 8-bit 125 MHz RAMDAC/Bt451 Triple 4-bit 125 MHz RAMDAC

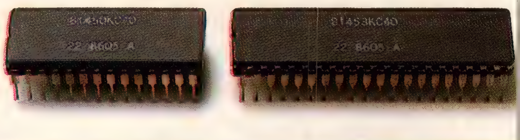
Ask about our Sidecar RAM.™

Here's a vivid example of our commitment to elegant design: Each of our four new RAMDACs includes two overlay ports that address a separate color palette. This makes cursors, menus, alphanumeric overlays, etc. easier to handle.

Because this Sidecar RAM, as we call it, stores the colors for these overlay options, all the colors in the color palette RAM can be used to display rendered images.

Ask about our Triple 4-bit RAMDAC.

Our Bt450 is a 70 MHz, 16-color palette, Triple 4-bit



Domestic Manufacturer's Representatives (203) 438-9644, (205) 881-2207, (206) 453-8881, (215) 233-4600, (216) 659-9224, (219) 423-1478, (301) 296-2444, (303) 779-8060, (305) 841-7423, (312) 298-2330, (313) 572-1950, (314) 291-0520, (315) 463-8592, (404) 381-1015, (408) 980-0812, (414) 547-1505, (416) 626-8221, (503) 620-1931, (505) 884-2256, (512) 331-8922, (513) 278-0714, (515) 225-0607, (516) 543-0510, (602) 949-0873, (612) 888-7011, (613) 236-1221, (614) 890-2743, (617) 692-7503, (619) 728-7678, (713) 776-8330, (801) 268-8440, (813) 443-6390, (817) 265-6007, (818) 991-4221, (913) 764-4460, (919) 872-3966, RAMDAC, Sidecar RAM and Pixel Rate Converter are trademarks of Brooktree Corporation.

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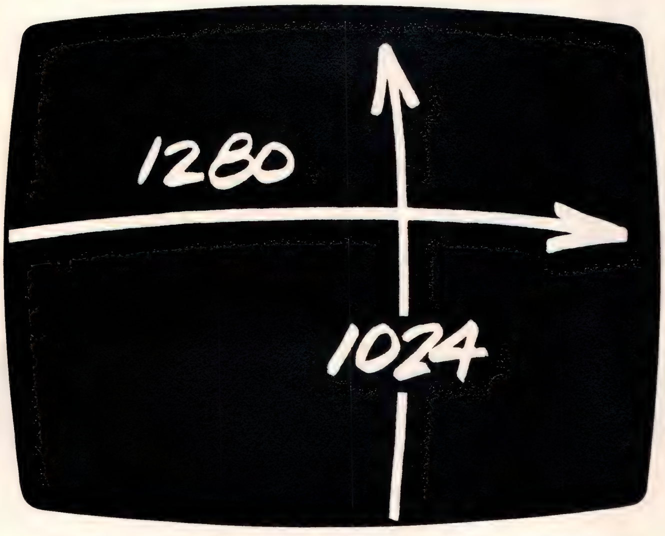
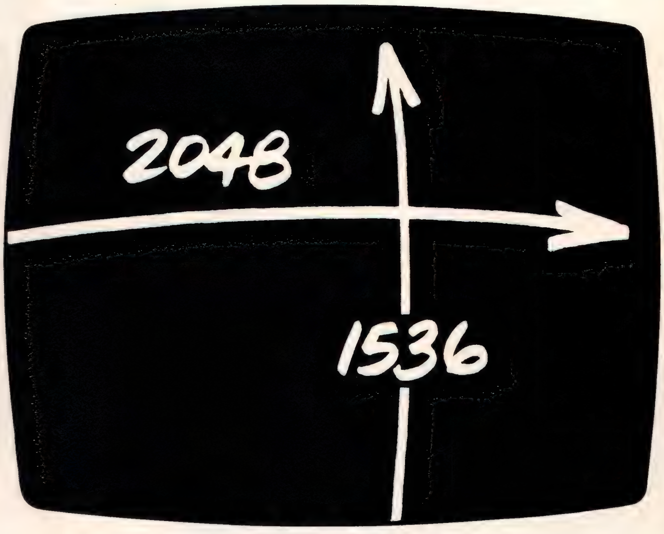
resolutionary RAMDACs.



HIGH RESOLUTION ENGINEERING WORKSTATIONS



ULTRA-HIGH RESOLUTION WORKSTATIONS

RAMDAC—in a single monolithic CMOS chip.

Compare it to the TMS34070. It has a voltage output. Ours has an adjustable current output that drives doubly-terminated 75-ohm coax directly. Their part doesn't.

Our color palette is fully dual ported. Not theirs.

Ours is RS-343-A compatible, including SYNC tip and blanking pedestal. Theirs isn't.

Most important, the Bt450's overlay RAM and separate MPU port makes your design job a lot easier.

Ask about our Triple 8-bit RAMDAC.

Our Bt453 is a 40 MHz, 256-color palette, Triple 8-bit RAMDAC—also in a single monolithic CMOS chip.

Frankly, it's not even fair to compare it to the IMSG170. It's six bits. Ours is eight.

So only Brooktree can give you, simultaneously, 256 colors out of a 16.8 million-color palette. That means you can do solids modeling without color compromise.

Who can you ask about our 125 MHz RAMDACs?

It's tough not having direct competition. Nobody to blow out of the water.

Our Bt451 is a 125 MHz 256-color palette, Triple 4-bit RAMDAC. The Bt458 is a pin-compatible 8-bit version. Also 125 MHz. Both TTL-compatible. *Not* ECL.

And because they're pin compatible, you can design one system that can be switched from 4-bit to 8-bit DAC resolution by exchanging just one chip.

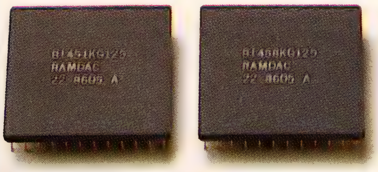
Just look at these features: On-chip 4:1 and 5:1 Pixel Rate Converter, direct interface to frame buffer RAM, separate MPU interface, blink/blank registers and fully dual-ported RAM cells.

Gee, do you think we should build a 250 MHz version, too?

Now, ask for more information.

We've told you a lot about our new RAMDACs. But far from the whole story. For samples, call the Brooktree representative nearest you. His responsiveness will absotively amaze you.

Brooktree Corporation,
9950 Barnes Canyon Rd.,
San Diego, CA 92121.
1/800/VIDEO IC
TLX 383 596



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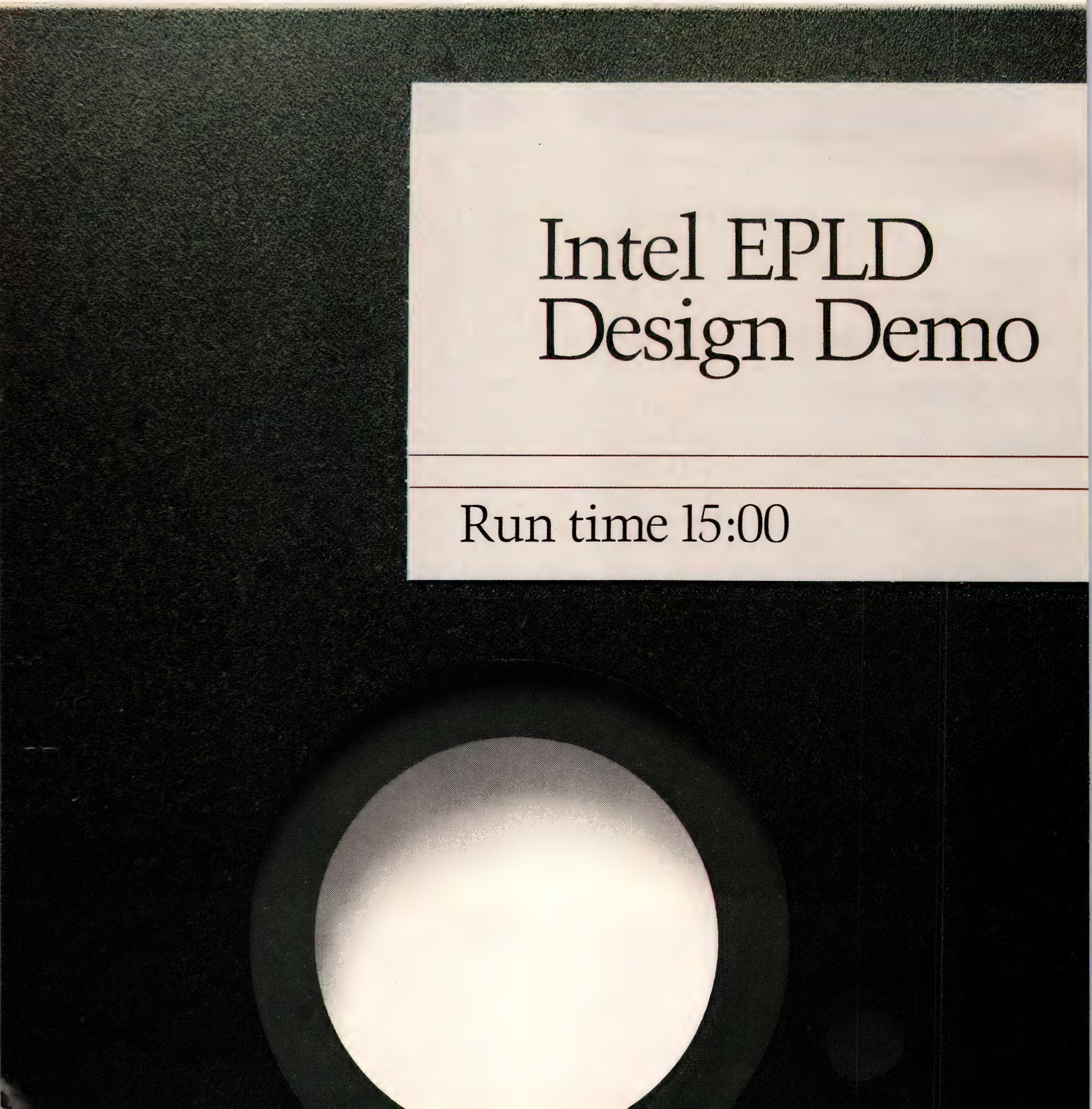
CIRCLE NO 169

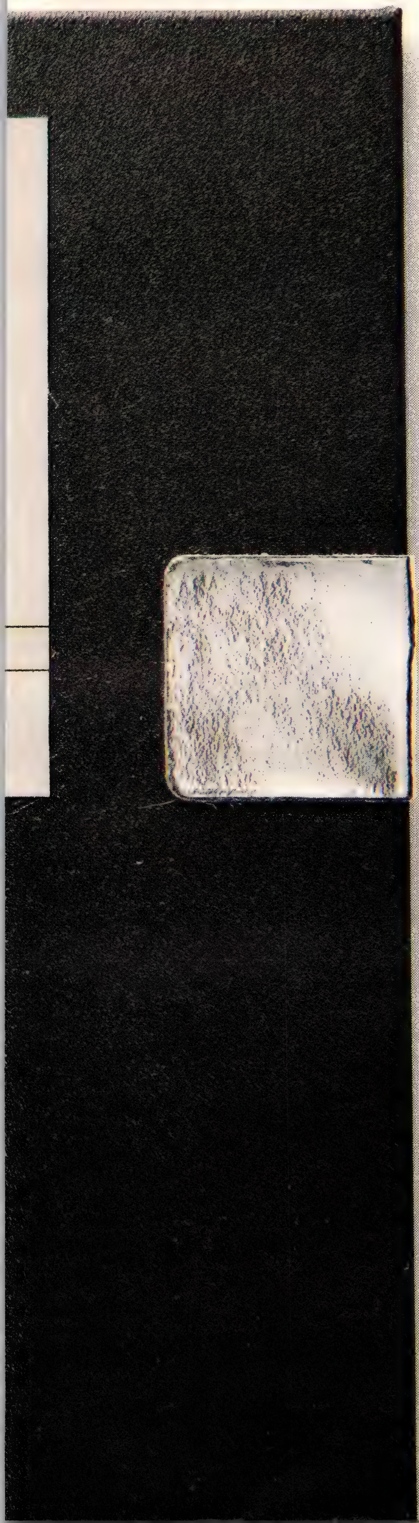
REPLACING
60 TTL DEVICES IS ONLY
A BOOT AWAY.



Suppose you could integrate the logic of several TTL devices into a single chip? Quickly. And easily.

Seeing is believing, right?

That's why we'd like to send you a **free** Intel design demo:



A step-by-step guide that shows you how to design using a single erasable programmable logic device (EPLD) as easily as you design using dozens of SSI/MSI devices.

Right on your own PC.

With Intel EPLDs, you can program, erase, and reprogram your designs. Just like with an EPROM.

And combined with our powerful development tools (iPLDS), designing is practically instantaneous.

Because unlike semicustom alternatives, Intel EPLDs don't require an expensive and lengthy development cycle.

Besides the obvious saving of precious board real estate and the increase in system reliability (one 1200 gate EPLD replaces 40-60 SSI/MSI devices), Intel EPLDs save power as well.

Because they're fabricated using Intel's proven CHMOS technology. Which yields high performance at extremely low power. Less than 1% of the power of a bipolar design.

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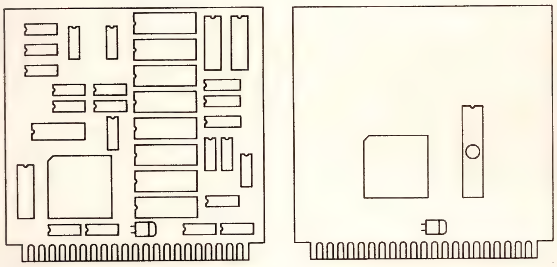
We've also made sure you have a choice of integration possibilities.

The Intel family of EPLD products includes the 5C031 (300 gate), 5C060 (600 gate), 5C090 (900 gate), 5C121 (1200 gate), and the 5C180 (1800 gate).

All of which have been designed to help you get to market faster than ever before. And that's the real name of the game.

For your free Intel EPLD design demo, just write us on your company letterhead or send a business card to: Intel Corp., Lit. Dept. W292, 3065 Bowers Ave., Santa Clara, CA 95051.



Reduce system size and cost by integrating TTL logic into a single Intel EPLD.

And see why Intel EPLDs are logical devices for getting into higher integration.

intel®

High-voltage circuits use mixed processes, fulfill diverse roles

Various high-voltage monolithic ICs simplify design tasks by taking over the roles of circuits that once required large numbers of discrete components. These ICs use a variety of processes, including bipolar, CMOS, DMOS, and combinations thereof. For functions difficult to realize in IC form, hybrids provide the solution.

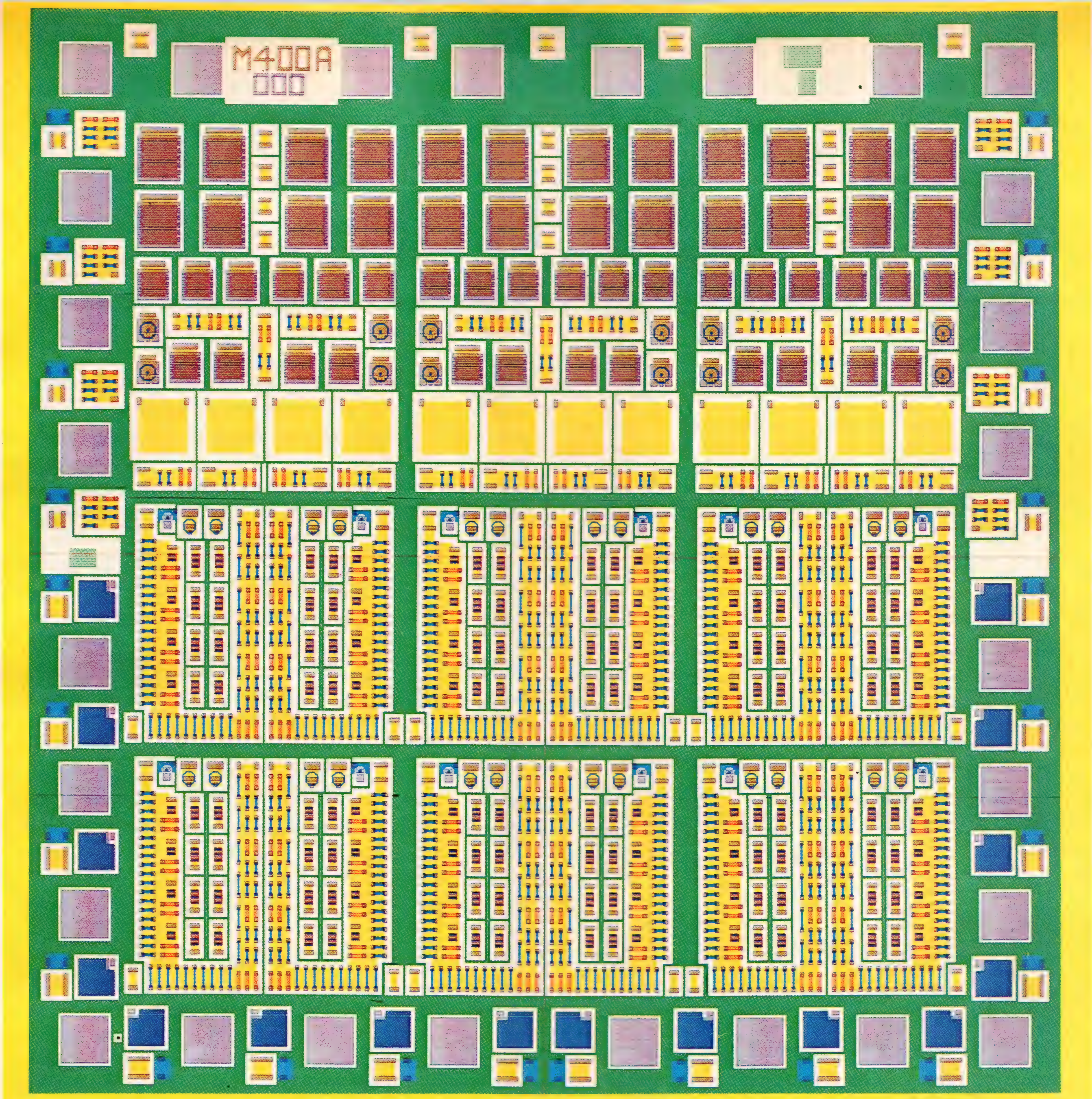
Bill Travis, *Senior Editor*

Modern ICs' ability to withstand high voltages, though apparently not basking in the limelight that enhanced density, speed, and precision enjoy, is advancing fully as rapidly as those three much-touted attributes. To those of you who can remember burning out vintage transistors by applying power-supply voltages 0.5V higher than the laughable 5V rating, the capabilities of these high-voltage ICs (some able to accommodate voltages as high as 450V) cannot fail to be impressive.

No single, dramatic improvement in IC fabrication processes can claim the credit for the advances in high-voltage capabilities. The enhancements owe their thanks, rather, to evolutionary improvements in the manufacturing processes for bipolar, MOS, and mixed-technology devices. In a sampling of the types of high-voltage devices recently available on the market, the discussion here covers switches (including multiplexers), drivers, semicustom ICs, and high-voltage hybrids (see **box,** "High-voltage hybrids exploit diverse processes").

Switches sustain high levels

One circuit category that's made a quantum leap in voltage-handling capabilities is the lowly (and formerly low-voltage) switch. Such CMOS devices as the ubiquitous, industry-standard 508 analog multiplexer, for ex-



***Bipolar linear array for custom ICs** (Tektronix Inc)*

ample, are shackled by a ±15V signal range. Recent units from Siliconix, Maxim, Supertex, and Telmos, however, use a combination of CMOS logic circuitry and double-diffused MOS (DMOS) output devices to extend the switched-voltage range to ±50V and even higher.

Consider, for example, Siliconix's DG568 and DG569 latchable multiplexers **(Fig 1)**, which are now available in production quantities. The DG568 **(a)** is an 8-channel, single-ended device; the DG569 **(b)** provides four differential-input channels. Both multiplexers use ±60V supplies and accommodate a ±50V input-signal range. The 8-channel unit, naturally, requires a 3-bit address word to select channels; the 4-channel DG569 requires a 2-bit word.

Over an input-voltage range of −50 to +30V, the two multiplexers spec an on-resistance of 30Ω typ, 50Ω max. For higher positive levels, the $R_{DS(ON)}$ increases: For the range 30 to 40V, the on-resistance is 50Ω typ, 100Ω max; for 40 to 50V, it's 300Ω typ, 500Ω max. For any combination of inputs, the combination of a positive-going signal on the $\overline{\text{WR}}$ pin and a logic one on $\overline{\text{RS}}$ causes the input latches to maintain the previously written address. A logic zero on $\overline{\text{RS}}$ holds all switches off. Both multiplexers switch on in 2 μsec max and off in 1 μsec max. Housed in 18-pin DIPs, both the DG568 and the DG569 cost $26.13 (100).

The fruit of a joint development effort

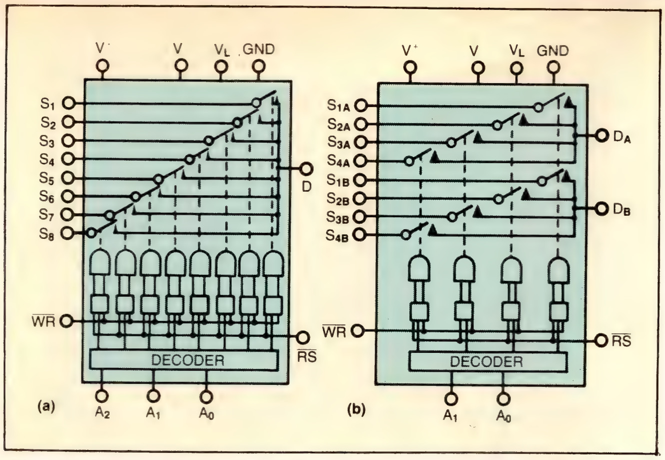


Fig 1—Designed for high-voltage, multichannel analog-signal-processing systems, *Models DG568 and DG569 multiplexers from Siliconix provide CMOS control of the linear signals. The parts accommodate ±50V signal levels and present a low 30Ω on-resistance to the signals. On-board latches and control pins simplify the devices' interface with microprocessors.*

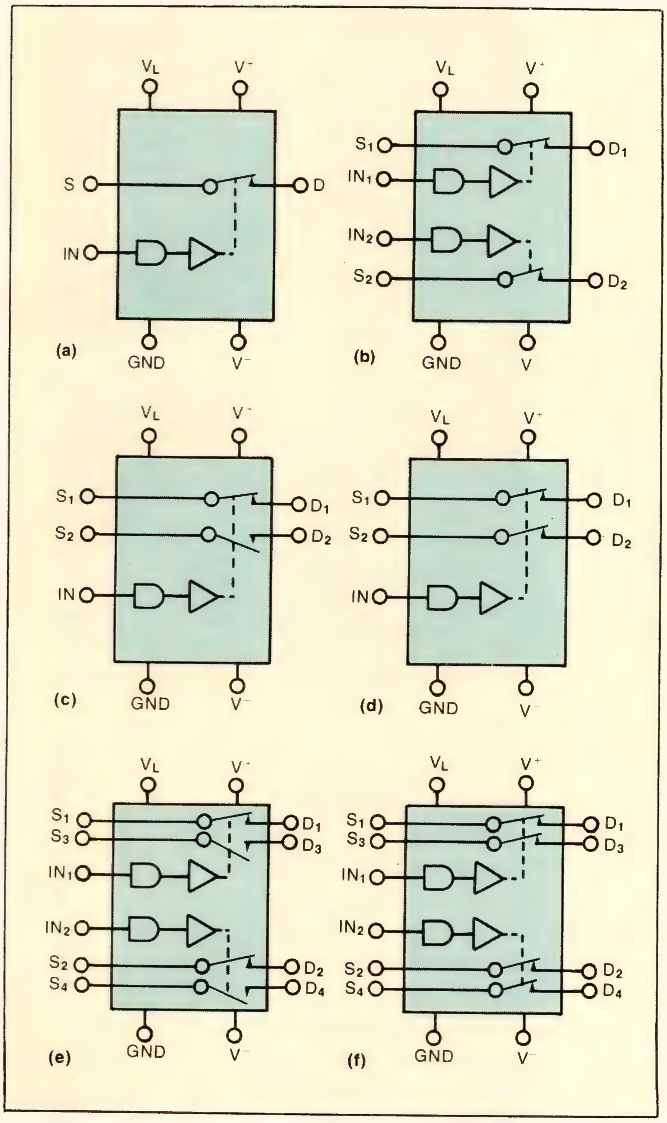


Fig 2—Various contact configurations are available *in these ±50V analog switches from Maxim and Supertex. A 160V CMOS process limits the switches' supply current to 100 μA, and leakage current to 1 nA. The ICs feature full protection against ESD damage and latch-up under fault conditions.*

between Maxim Integrated Products and Supertex is a series of as-yet-unnamed analog switches, which operate over a ±50V input-signal range. Thanks to a 160V CMOS process, the switches can operate from ±60V supplies (±75V max). According to Maxim, the devices are fully protected against electrostatic discharge and latch-up in the presence of fault conditions. For the ±50V signal range, the on-resistance is 25Ω typ. The parts are drop-in replacements for the IH5040-45, manufactured by GE/Intersil and others.

Other typical specs for the imminent Maxim and Supertex units include 800-nsec on and off switching times; 1-nA leakage current; 100-μA quiescent current; 94-, 74-, and 50-dB off-state isolation ratios at 1 kHz, 1 MHz, and 10 MHz, respectively; and on and off capacitances of 30 and 20 pF, respectively. Inasmuch as the switches' DMOS output transistor can pass current in only one direction, the switches use two DMOS transistors in series. At any time, one of the devices acts as a normal MOSFET until $R_{DS(ON)} \times I_{D(ON)}$ equals one diode drop, after which the second device starts to exhibit a diode characteristic. The output section's resistance, therefore, assumes the characteristics of a resistor at low currents and a resistor in series with a diode at high currents.

Fig 2 shows the various switch configurations available in the Maxim/Supertex high-voltage switches. The circuits in **Figs 2a** and **2b** are single and dual spst switches. In **Figs 2c** and **2d,** one logic signal controls two spst switches; **2e** and **2f** are dual configurations of the circuits in **2c** and **2d,** respectively. The switches will be available in TO-100 metal cans and 16-pin DIPs.

Serial switchery

If you need multiple spst switches with voltage capabilities even higher than those of the units described thus far, consider Model TMH5008 from Telmos. Operating from ±100V supplies, the 8-switch device commutates voltages covering a 180V span (−100 to +80V). The TMH5008 accepts a serial input (D_{IN}). **Table 1** shows that the status of any given switch depends on the logic state of the switch's bit position in the serial input word—for example, a logic zero and a logic one on D_0 correspond to the off and on states, respectively, in switch S_0.

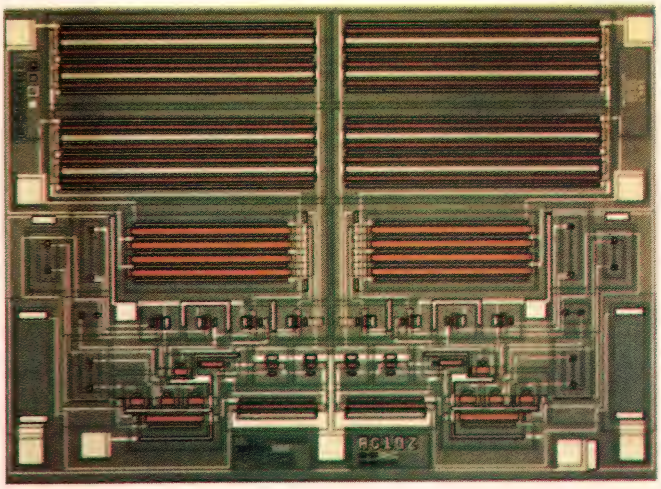
Hold control $\overline{G}$ allows you to activate the switches ($\overline{G}$ low), or to make the IC retain the switch status determined by the last active input word ($\overline{G}$ high). The maximum on-resistance for the TMH5008 is 30Ω for a 0V switched voltage, and the data sheet specifies a 20%

Evolutionary improvements in the manufacturing processes for bipolar, MOS, and mixed-technology devices have led to improved voltage handling in today's ICs.

max change in R_{ON} over a ±50V range. The bidirectional switches can sink or source 300 mA max over a ±80V switched-voltage range.

Quiescent current in the V_{CC} line is 10 mA max, and the HV^+ and HV^- high-voltage supply lines draw 2 mA max. Over a switched-voltage range of ±80V, the off-state leakage current in the switches is 500 nA max. The required V_{CC} supply is 15V, and logic-high and -low limits are specified at 12 and 1.4V, respectively. Other specs include 5-μsec max turn-on and -off times; 20-pF max switch capacitance; 50-dB min off-state isolation, and 40-dB min channel-to-channel isolation (both isolation specs reflect a 10-MHz operating frequency). Model TMH5008 comes in a 24-pin, double-width, plastic or ceramic DIP. In plastic, the part costs $35.40; in ceramic, $39.70 (100).

Perhaps the most pervasive application for high-voltage driver ICs is in flat-panel displays. Other uses for these devices also come to mind—for example, electrostatic printheads and piezoelectric elements in ink-jet printers. Recently introduced drivers from Sprague Electric, Supertex, and Telmos combine CMOS logic and DMOS drivers to advance the state of the art in driver-IC voltage and current ratings. The Sprague device has a bipolar output transistor.



High-voltage switches *(Maxim Integrated Products and Supertex)*

Model UCN-5910A **(Fig 3a)** from Sprague is a 10-bit, serial-input latched driver whose output stage **(3b)** comprises an npn Darlington pair for sourcing current and a DMOS transistor for sinking load current. The active pull-down feature provided by the DMOS device improves output switching characteristics over alternatives that use passive pull-down circuitry. The 150V, ±50-mA output-drive capability of the UCN-5910A makes the device useful as a driver for vacuum-fluores-

Text continued on pg 180

TABLE 1—TRUTH TABLE FOR THE TMH5008 ANALOG SWITCH

D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	$\overline{G}$	S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7
L								L	OFF							
H								L	ON							
	L							L		OFF						
	H							L		ON						
		L						L			OFF					
		H						L			ON					
			L					L				OFF				
			H					L				ON				
				L				L					OFF			
				H				L					ON			
					L			L						OFF		
					H			L						ON		
						L		L							OFF	
						H		L							ON	
							L	L								OFF
							H	L								ON
X	X	X	X	X	X	X	X	H	HOLD PREVIOUS STATE							

High-voltage hybrids exploit diverse processes

As impressive as the performance of the ICs described in the main text may be, the devices can't satisfy all conceivable high-voltage applications. In some cases, the 1-chip integration of a total system function is physically impossible; in others, it's impractical. In such cases, a multichip hybrid approach is often a technically and economically viable solution.

An example of an impossible-to-integrate function is a circuit that uses photocoupled devices. Such a circuit uses light generated by an input LED to drive a phototransistor or photodiode that's connected to—or incorporated in—control circuitry that in turn drives an output device. Two recent solid-state relays from Telmos and International Rectifier are good examples of high-voltage hybrid ICs that use photocoupling.

Models TMH5501 and TMH5551 ac/dc relays **(Fig A)** from Telmos are normally open spst relays that accommodate 250 and 450V peak load voltages, respectively. Both devices exhibit a control-to-switch isolation of 2500V min. The ICs comprise a discrete LED and a monolithic photodiode stack, monolithic pull-down circuitry, and high-voltage DMOS output FETs in chip form.

Specs for the TMH5501 and TMH5551 relays include 30 and 50Ω max on-resistance (respectively), an off-state leakage current of 1 µA max, and turn-on and -off times of 300 and 140 µsec max, respectively. Both devices can conduct a 250-mA peak load current. Continuous current for the TMH5501 is rated at 100 mA max; for the TMH5551, it's 80 mA max. Both units come in 6-pin DIPs and operate over 0 to 70°C. The TMH5501 costs $3.10; the TMH5551, $3.65 (100).

Solid-state relays conduct 3A

The ChipSwitch solid-state relays from International Rectifier's Crydom Division suit ac applications and conduct a hefty 1.2A rms at a 25°C ambient temperature; they conduct 3A rms if you provide a heat sink that holds the devices' case temperature to 25°C. **Fig B** shows a typical connection for the 24 to 140V rms HCS140 or the 24 to 280V rms HCS280.

Both relays contain two identical power ICs connected in an inverse-parallel configuration (much like that of back-to-back SCRs) for ac control, plus an isolated LED that actuates the power chip. The power ICs contain output devices fabricated with the company's HexFET process.

Specs for the HCS140 and -280 include 5-mA max input turn-on current, 8.3-msec max turn-on time for 60-Hz signals, and 600V/µsec min rated off-state dV/dt at the maximum rated voltage. The relays' output stages can conduct nonrepetitive surge currents of 30 and 10A peak for 20 msec and 1 sec, respectively. The maximum I^2T product for fusing (over a 10-msec period) is 5 A^2sec. The off-state leakage current is 10 µA rms at the rated voltage.

The HCS140 and -280 come in 4-pin metal DIPs and are designed to meet the environmental conditions of MIL-R-28750 and MIL-STD-883B. The operating-temperature range is −30 to +85°C. The relays spec 1500V rms input-output dielectric strength and $10^9\Omega$ I/O isolation resistance. The parts are standard, single-pole relays; custom, multipole units are available on special order. The price is $30 per pole.

Power hybrid has smart IC

As noted, sometimes it's merely impractical to integrate an entire circuit on one silicon chip. Putting large power devices, for example, on the same chip as their control and drive circuitry could be unwise, from two perspectives: thermal per-

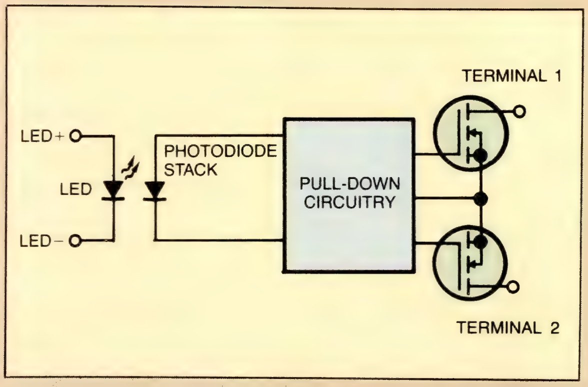


Fig A—Photocoupled devices provide 2500V isolation *in the TMH5501 and TMH5551 solid-state relays from Telmos. The ICs are totally immune to false turn-on, and they generate no switching RFI.*

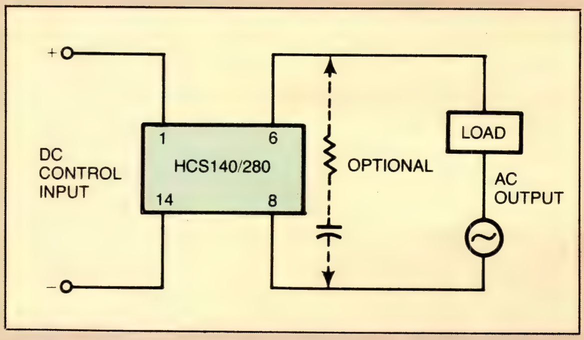
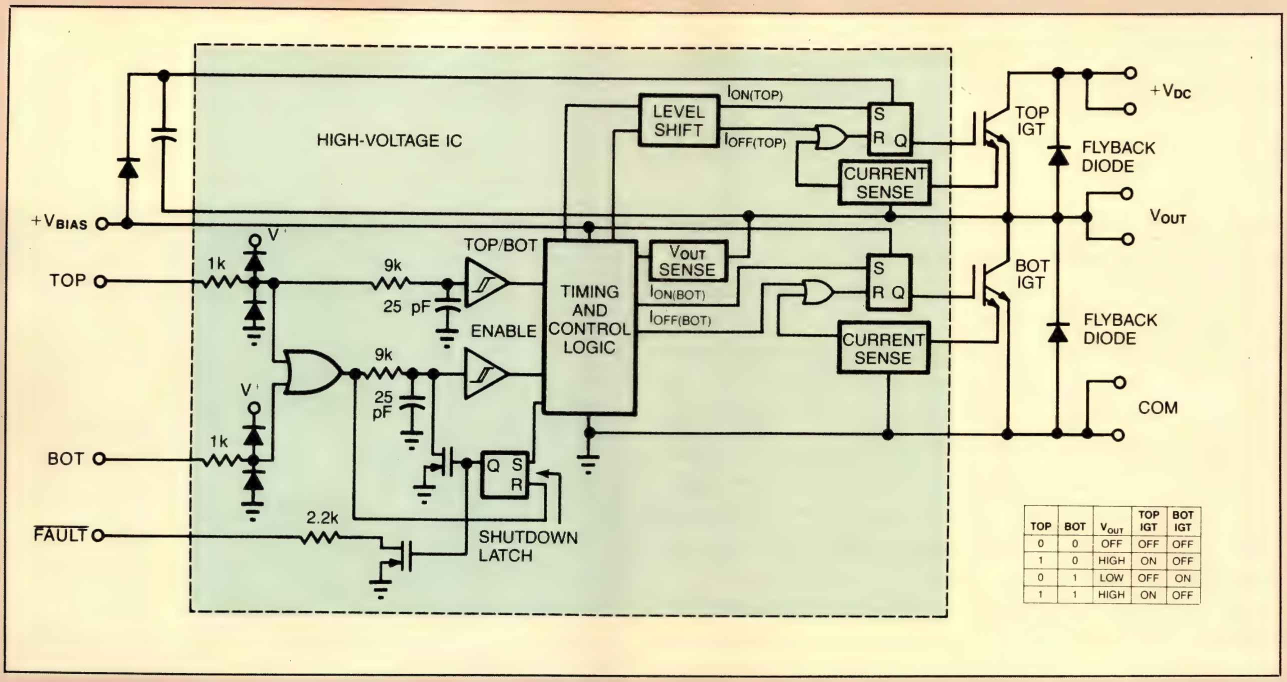


Fig B—Designed to meet MIL environmental standards as well as FCC and VDE emission requirements, *the HCS140 and HCS280 solid-state relays from International Rectifier conducts 3A load current and withstands 300 or 450V pk. The input current required for full output turn-on is 5 mA.*



TOP	BOT	V_{OUT}	TOP IGT	BOT IGT
0	0	OFF	OFF	OFF
1	0	HIGH	ON	OFF
0	1	LOW	OFF	ON
1	1	HIGH	ON	OFF

Fig C—Combining a "smart" driver IC and special IGTs, *the GS1E10MA half-bridge motor driver from General Electric withstands 500V supplies and can conduct 30A peak collector current. The output IGTs feature a special sense emitter for use by the current-sensing circuitry in the driver IC. Designed for fail-safe operation, the hybrid module uses nonlatching CMOS logic and requires no snubbers at the output.*

formance and silicon area. A hybrid circuit is often a space-saving and cost-efficient solution in these cases; a good example of such a hybrid device is General Electric Semiconductor's GS1E10MA half-bridge motor driver (**Fig C**).

Housed in a 1.83×0.87×0.24-in. single-in-line package that incorporates an isolated heat-sink surface, the device provides ±10A push-pull outputs and operates from voltage levels as high as 500V. The ±10A spec holds for a 25°C case temperature; the spec decreases to ±5A at a 100°C T_C. Peak current, for both the insulated-gate transistors (IGTs) and the flyback diodes, is rated at 30A max.

The control and drive circuitry within the broken lines of **Fig C**'s schematic is integrated onto one silicon chip. Note the output IGTs: They incorporate an extra emitter that allows the control circuitry to sense the current flowing in the IGTs. This sense-terminal arrangement makes eminent sense in current-feedback systems; witness the emergence of sense-cell MOSFETs from several manufacturers. The sense-terminal IGTs are not yet available as discrete devices from GE, but the company plans to release them soon.

Digital IGT-output control

Using nonlatching CMOS-logic inputs, the GS1E10MA provides digital control of the IGT output switches. The control logic includes fixed timing to prevent simultaneous conduction of the two IGTs, and, via the V_{OUT} sense detector, it verifies that the output-voltage state is in agreement with the control inputs after the completion of an IGT's turn-on.

In addition to providing low-impedance drive to the IGTs' gates, the upper and lower drive circuits also contain overcurrent and out-of-saturation detectors. The upper IGT derives its bias from a diode-capacitor bootstrap circuit; the V_{BIAS} supply refreshes the capacitor each time V_{OUT} switches low. If the upper IGT remains on, the bootstrap capacitor's voltage droops, causing the IGT to go out of saturation. The out-of-saturation detector then shuts the IGT off, and the control logic initiates a refresh cycle and starts a fault-observation timer.

The refresh cycle causes V_{OUT} to go low; the bootstrap capacitor then recharges to turn the upper IGT back on. A second overcurrent/out-of-saturation fault before timeout of the observation timer causes the hybrid module to shut down and generates a $\overline{\text{FAULT}}$ output signal. Shutdown also occurs upon detection of overcurrent/out-of-saturation conditions in the bottom IGT or upon detection of invalid-V_{OUT} status. You reset the module by applying a logic-zero signal to both the TOP and BOT inputs.

High-voltage switches and multiplexers provide logic-level inputs to facilitate the microprocessor-based manipulation of single or multiple high-level analog signals.

cent or gas-discharge flat-panel displays, or for piezoelectric or electrostatic elements in printers.

The UCN-5910A operates from 15 and 150V and has high-impedance CMOS input circuitry that draws 100-μA max input current for a 12V logic-one input. Serial input data transfers to the shift register on the one-to-zero transition of the clock pulse. On succeeding clock pulses, the registers shift data toward the register's serial-data output. Data bits present in the register transfer to their respective latches when the strobe is high, and the latches continue to accept new data as long as the strobe remains high.

In applications in which the latches are bypassed (ie, the strobe is always high), you must ensure that the blanking input remains high during serial-data entry. When the blanking input is high, all the output buffers are low and have no effect on the information stored in the latches or the shift register. When the blanking input is low, the latches control the outputs. The UCN-5910A operates at 5-MHz data rates and comes in a 20-pin DIP. It costs $2.39 (100).

***Hybrid half-bridge motor driver** (General Electric Semiconductor)*

Intended to drive electroluminescent (EL) flat-panel displays, Supertex's HV51/52/53/54 drivers are 32-channel, serial-input, parallel-output drivers that incorporate CMOS logic circuitry and DMOS output stages. Like Sprague's recently introduced UNC-5851/5852/5853/54 drivers (EDN, May 1, 1986, pg 58), the devices are alternatives to Texas Instruments' vintage SN75551/2/3/4 EL-driver chips.

Models HV51 and HV52 are 225V row drivers whose open-drain outputs can sink 100 mA min. The two units differ only in the pinout assignments in their 44-pin, J-lead ceramic or plastic chip carriers. The HV53 and HV54 column drivers provide output voltages of 60 or 80V, depending on the version you select, and sink or source currents as high as 20 mA. The packaging is the same as that of the HV51 and HV52; again, the HV53 and HV54 differ only in pinout assignments. Compared with the SN75551/2 parts, the HV51 and HV52 handle

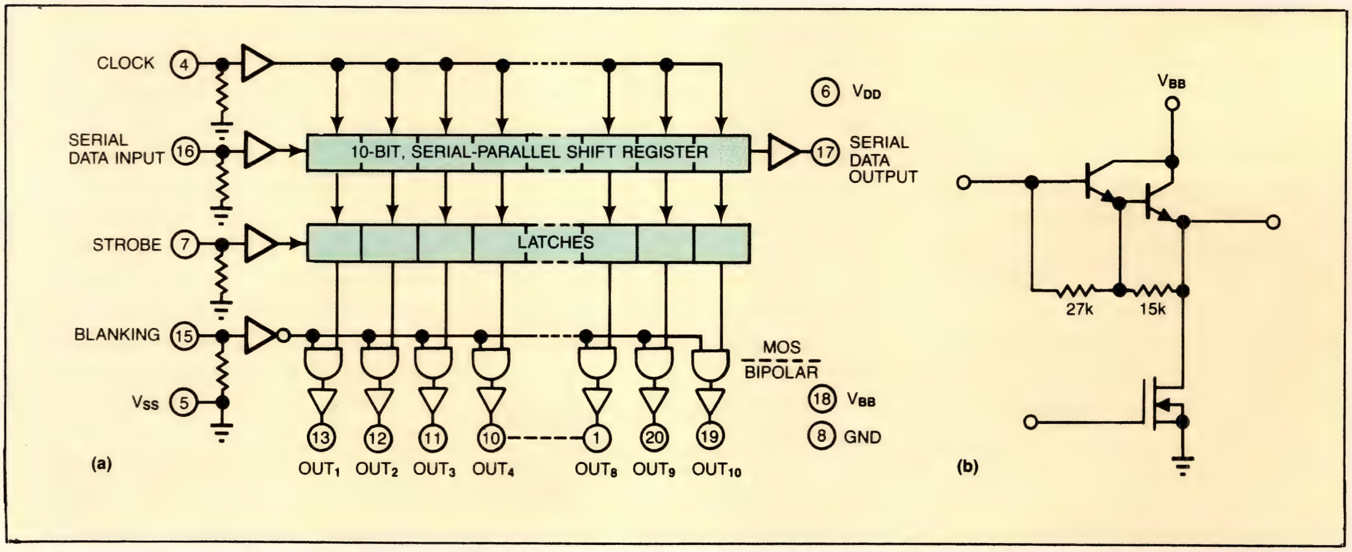


***Fig 3—A serial data input reduces the pin count** in the UCN-5910A high-voltage latched driver **(a)** from Sprague Electric Co. The IC's output stage **(b)** comprises an npn Darlington pair for sourcing current and a DMOS transistor for sinking load current.*

higher current (100 vs 50 mA) and operate faster (8 vs 4 MHz). Similarly, the HV53 and HV54 improve on the SN75553/4 parts' current and speed: ±20 vs ±15 mA and 8 vs 6.25 MHz. Prices range from $5.48 to $5.76 (100) for parts in plastic packages.

Dielectric isolation for 450V switching

If you need ICs that are capable of switching extremely high voltages (eg, 500V), devices that employ dielectric-isolation processing are a good choice. This process allows 500V n- and p-channel DMOS driver transistors and 10V signal-processing CMOS devices to coexist on a chip. What's more, although it's nominally a more expensive process than junction isolation, dielectric isolation can save money in high-voltage applications, because the process makes it possible to use smaller active devices for a given voltage rating.

One company that capitalizes on the properties afforded by dielectric isolation processing is Telmos. The TMH5801 and TMH5802 drivers both contain eight independent channels of push-pull DMOS drivers. The ICs operate from +450 and −450V supplies, respectively, and provide drive currents as high as 170 mA. The parallel-input and -output drivers use CMOS-logic input stages to provide the interface between the high-voltage driver stages and a μP bus; internal level shifters provide the interface between the CMOS logic and the high-voltage drivers.

The on-resistance in the current-sourcing mode is 80Ω max, and in the sinking mode it's 100Ω max. Compatible with CMOS logic and TTL levels, the inputs have switching thresholds of 0.8V max and 2.4V min. **Table 2** shows the influence of the output-enable, clock-enable, and input pins. The output-transition delay from the application of a clock-enable or output-enable command is 200 nsec max; output rise and fall times are 500 nsec max. Both the TMH5801 and TMH5802 come in single-width, 24-pin ceramic DIPs and operate over 0 to 70°C.

High voltage and current coexist

MOS-device output stages are the common denominator for the high-voltage ICs discussed thus far. However, though the MOS transistors offer excellent voltage-withstanding properties, their high on-resistance precludes their use in applications requiring both high voltages and high currents. To satisfy such requirements, a series of Darlington arrays from Sprague Electric provides both hefty current ratings and high voltage-handling capabilities.

Models ULN-7064B, -7068B, and -7074B are quad Darlington arrays, all of which incorporate open-collector Darlington pairs that spec a 150V min breakdown voltage and a 90V min sustaining voltage. Containing integral transient-suppression diodes, the ICs can sink (or, in the case of the ULN-7074B, source) 1A of continuous output current.

Partial schematics for the three Sprague Darlington arrays are shown in **Fig 4.** The ULN-7064B **(Fig 4a)** is the basic driver; Model ULN-7068B **(4b)** provides addi-

TABLE 2—TRUTH TABLE FOR THE TMH5801/5802 OCTAL DRIVERS

OUTPUT ENABLE	CLOCK ENABLE	INPUT N (0 TO 7)	TMH5801 OUTPUT N (0 TO 7)	TMH5802 OUTPUT N (0 TO 7)
LOW	HIGH	HIGH	0V	HV−
LOW	HIGH	LOW	HV+	0V
LOW	LOW	DON'T CARE	PREVIOUS STATE	PREVIOUS STATE
HIGH	DON'T CARE	DON'T CARE	0V	0V

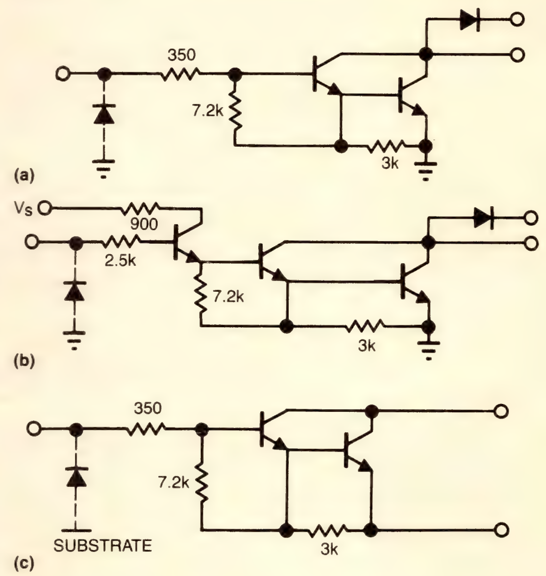


*Fig 4—**Classic bipolar Darlington output circuitry** characterizes the ULN-7064B, -7068B, and -7074B high-voltage arrays from Sprague Electric. The three output configurations in **a, b,** and **c** allow you to choose the one most appropriate for your application.*

> *The breakdown-proof output stages in high-voltage ICs let you dispense with bulky and expensive outboard voltage-boosting devices and spike-suppression circuitry.*

tional input buffering to minimize input loading. For applications requiring high-side switching or output-current sensing, the ULN-7074B **(Fig 4c)** renders the Darlington pairs' emitters accessible. All three driver circuits come in 16-pin DIPs; the bat-wing double tabs in the center of the DIP act as heat sinks. All three parts cost $1.87 (100).

For high-voltage applications requiring even more current, Sprague's UDN-7078W performs the same function as the ULN-7068B but handles three times the current: 3 vs 1A. Like the 7068B, this device incorporates transient-suppression diodes and specs 150 and 90V breakdown and sustaining voltages, respectively. The IC's 12-pin, power-tab package takes the credit for the driver's power-handling capability. The large tab (at ground potential) on the single-in-line package provides the heat-sinking medium for the UDN-7078W. Production quantities of the device will be available in the third quarter of this year.

Customize your high-voltage IC

Imagine a situation in which your application needs an IC with high-voltage capabilities, but no available IC fills the bill. You could satisfy the requirement by using discrete circuitry, or you could specify and purchase a custom IC. A possible problem with the second approach is one of control: After building the breadboard and testing the circuit using discrete devices, you can't be sure the finished IC's on-chip devices will display the same parametric characteristics as the discrete devices.

Two manufacturers are tendering solutions to the custom-design problem. Tektronix and Telmos offer high-voltage ICs that allow you to design semicustom or full-custom units that have predictable characteristics.

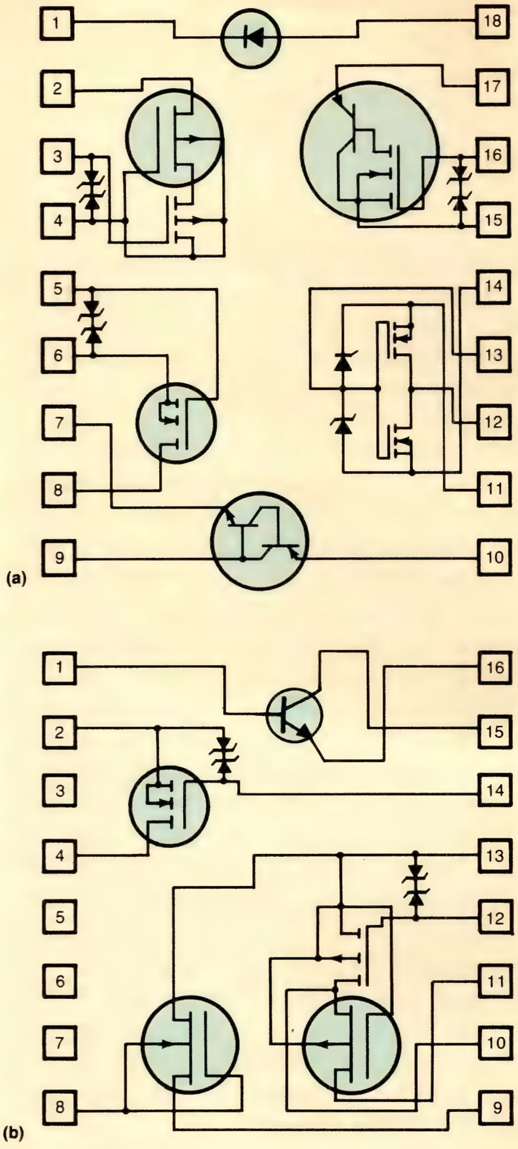


*Fig 5—**Roll your own high-voltage custom IC** by making a breadboard using the devices in Telmos's high-voltage kits. According to the manufacturer, the performance of a finished custom IC conforms closely to the performance of the breadboard incorporating the kit parts.*

TABLE 3—COMPONENT COMPLEMENT FOR THE QUICKCHIP 3

COMPONENT TYPE	LOW-VOLTAGE CELL		HIGH-VOLTAGE CELL		EXTERNAL TO CELLS
	PER CELL	TOTAL	PER CELL	TOTAL	
LOW-VOLTAGE NPN	24	144			
HIGH-VOLTAGE NPN			18	54	
LATERAL PNP	4	24	4	12	
SUBSTRATE PNP	2	12			
IMPLANTED RESISTORS	128	768	32	112	56
HIGH-VOLTAGE CAPACITORS			4	12	
LOW-VOLTAGE CAPACITORS					16
BONDING PADS					28

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DMOS transistors are usually the output devices of choice in high-voltage switches; driver ICs use both MOS-transistor and bipolar-Darlington output circuitry.

The QuickChip 3 from Tektronix is a bipolar linear array composed of transistors, resistors, and capacitors organized in a cellular structure. The part has 198 npn and 36 pnp transistors organized into six low-voltage cells and three high-voltage cells.

Table 3 gives the component count for the QuickChip 3. The low-voltage transistors withstand 15V; the high-voltage devices, 65V. The low- and high-voltage npn transistors spec a typical f_T of 2.5 GHz, and the pnp devices' f_T is typically 50 MHz. Tektronix provides Spice circuit models for all devices. You can do layouts either by hand or by using the QuicKic graphics editor available from Tektronix.

Small die fits in 24-pin DIP

The dimensions of the QuickChip 3 semicustom chip are 2.97×3.05 mm; the die will fit into packages as small as a 24-pin DIP. Resistors on the chip are of two types: implanted and deposited thin film. The implanted resistors have values of 100, 200, 3000, and 4000Ω; the thin-film, laser-trimmable nichrome resistors (deposited only upon the customer's demand) cover the 10Ω to 10-kΩ range. Laser trimming allows you to specify tolerances as tight as 0.01% for the thin-film resistors.

Capacitors on the QuickChip 3 are of three types: low- and high-voltage MOS, and junction. Each high-voltage cell contains four high-voltage MOS capacitors. Sixteen low-voltage MOS capacitors occupy spaces between the pads in the low-voltage section of the IC. Each MOS capacitor has about 1-pF capacitance (programmable by varying the IC's metallization pattern); the junction capacitors have values of about 2.7 pF. You can receive finished QuickChip wafers within three weeks of layout approval. The typical cost for prototype wafers or packaged parts is $17,000; NRE charges vary according to the customer/supplier design apportionment.

A full-custom tool kit

For applications in which voltage levels don't exceed 65V, the QuickChip 3 can provide a quick and easy way to design tailor-made, moderately high-voltage ICs. For systems requiring much higher voltages, you must consider other approaches. One way to design a custom IC and to be sure of what you're getting in the final design is to use high-voltage "kit" parts **(Fig 5)** from Telmos. The parts are designed for creating breadboards for circuits destined to be integrated into a high-voltage IC.

The TMH5155 kit **(Fig 5a)** contains a low-voltage CMOS inverter; all the other devices are high-voltage (450V) components. Included are a p-channel (pins 2, 3, and 4) and an n-channel (pins 5, 6, and 8) enhancement-mode DMOS FET; an insulated-gate thyristor (pins 15, 16, and 17); a bipolar thyristor (pins 7,9, and 10); and a diode. This IC, like other very high-voltage parts from Telmos, employs the dielectric-isolation process.

Another kit from Telmos, Model TMH5156 **(Fig 5b)**, deletes the TMH5155's thyristors, diode, and CMOS inverter and adds a high-voltage npn bipolar transistor and an n-channel depletion-mode FET (pins 8, 9, and 13). The depletion-mode FET is useful in applications that employ normally closed switches. Both the TMH5155 and the TMH5156 cost $8.90 (100). **EDN**

For more information . . .

For more information on the high-voltage ICs discussed in this article, contact the following manufacturers directly or circle the appropriate numbers on the Information Retrieval Service card.

General Electric Semiconductor
318 First St
Liverpool, NY 13088
(315) 457-9333
Circle No 701

GE/Intersil
10600 Ridgeview Ct
Cupertino, CA 95014
(408) 996-5000
Circle No 702

International Rectifier
Crydom Solid-State Products Div
1521 Grand Ave
El Segundo, CA 90245
(213) 322-4987
Circle No 703

Maxim Integrated Products
510 N Pastoria Ave
Sunnyvale, CA 94086
(408) 737-7600
Circle No 704

Siliconix Inc
2201 Laurelwood Rd
Santa Clara, CA 95054
(408) 988-8000
Circle No 705

Sprague Electric Co
115 Northeast Cutoff
Worcester, MA 01606
(617) 853-5000
Circle No 706

Supertex Inc
1225 Bordeaux Dr
Sunnyvale, CA 94088
(408) 744-0100
Circle No 707

Telmos Inc
740 Kifer Rd
Sunnyvale, CA 94086
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CIRCLE NO 103

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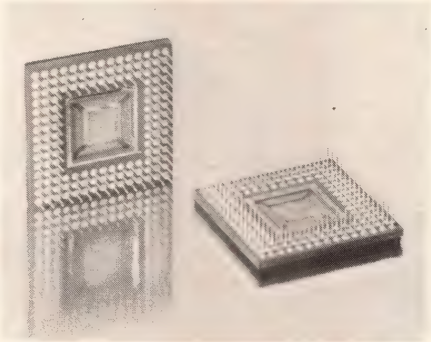
64-bit floating-point processors perform single-precision math at 40M-flops rate

The 2264 and 2265 floating-point chip set can perform single-precision arithmetic at a maximum of 40M flops. They perform double-precision arithmetic at rates as high as 24M flops and 64-bit multiplications at 10M flops.

The processors can run microcode written for the company's 1264 and 1265 processors. The 2264 and 2265 are hardware compatible with the 1264 and 1265. You can install the 2264 and 2265 in systems configured for the 1264 and 1265 without modifying the hardware, but you will need to make minor modifications to the software to take full advantage of the advanced chips' performance.



The chips conform to the IEEE 754, V.10 standard for floating-point operations. ALU operations and 64-bit accumulations require as little as 50 nsec. A 64-bit multiplication takes 100 nsec, and a 64-bit divide operation takes 800 nsec.

Each device consumes less than 1W and comes in a 144-pin pin-grid-array package. Initial samples will have a 75-nsec min multiplication time. Sample quantities (100) of the set will be available in June for $700; production quantities will be available in July.

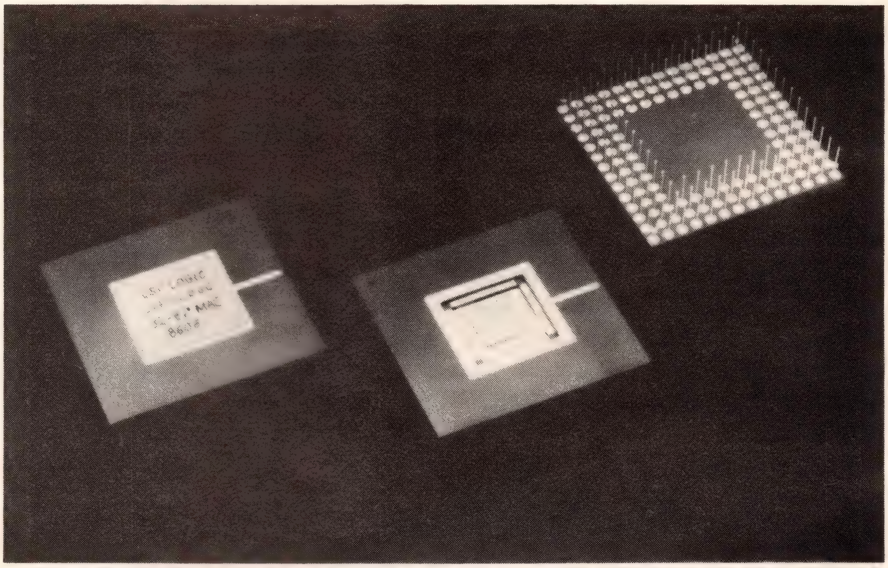
Weitek Corp, 1060 E Arques Ave, Sunnyvale, CA 94086. Phone (408) 738-8400.

Circle No 710

CMOS multiplier/accumulator chip multiplies 32-bit numbers in 80 nsec

The L64032 multiplier-accumulator can multiply two 32-bit numbers in 80 nsec, even under worst-case commercial conditions. Working with fixed-point numbers, the device can perform a double-precision 64×64-bit multiplication in four clock cycles.

This CMOS IC is as fast as comparable bipolar multiplier-accumulators, but its rated power consumption (1W max) is at most 20% of the nominal current specified by the bipolar ICs. Its architecture employs Booth-encoding, Wallace-tree, and carry-select techniques to achieve performance levels equivalent to the bipolar devices. The chip incorporates scan testing that allows you to read and preload all on-chip registers; the ability to monitor internal registers aids in both board and system-level testing.

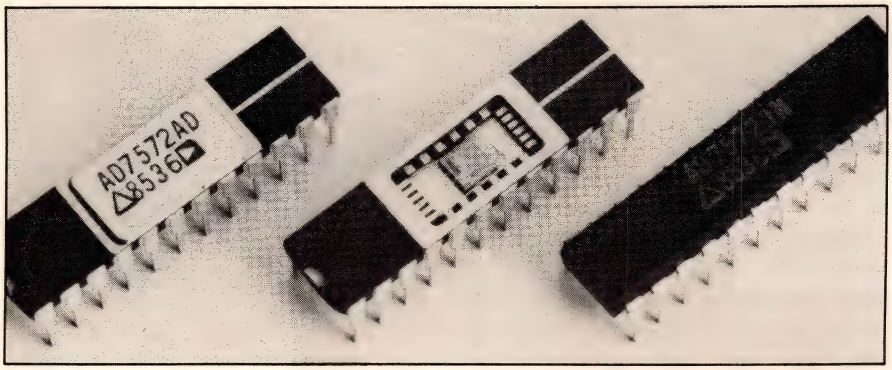


The L64032 is the vendor's first standard product and is a product of the company's Macgen megacell compiler. The part comes in three speed grades and is specified for either the commercial or military temperature ranges. It's fabricated in 1.5-μm CMOS technology, comes in a 132-pin pin-grid-array package, and costs $350 (100). You can also use the L64032's layout as the basis for a custom-IC design.

LSI Logic Corp, 1551 McCarthy Blvd, Milpitas, CA 95035. Phone (408) 263-9494.

Circle No 725

135-mW CMOS monolithic A/D converter performs 12-bit conversions in 5 μsec



The AD7572 monolithic A/D converter can perform 12-bit conversions in only 5 μsec. The CMOS chip consumes a maximum of 215 mW from +5 and −15V supplies. It includes a buried-zener voltage reference that has a temperature coefficient as low as 25 ppm/°C. Because the chip also includes a clock circuit, the only external components you need to operate it to specification are a crystal for the clock circuit, decoupling capacitors for the supply voltages, and two capacitors on the reference-voltage output.

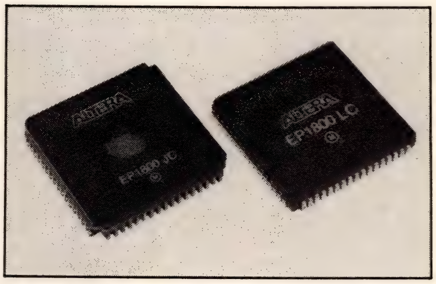
The outputs of the AD7572 contain 3-state drivers that can operate under the control of a μP's read and address signals, simplifying the interface to μP-based systems. Three-state enable and disable times are 90 and 75 nsec, respectively. A μP can read the data either 12 bits at a time or multiplexed over an 8-bit bus.

The converter is available in either a 24-pin DIP or a 28-pin LCC. You can specify the following parameters when ordering: commercial (0 to 70°C), industrial (−25 to +85°C), or military temperature range (−55 to +125°C); ±1 LSB or ±½ LSB nonlinearity; 25 or 45 ppm/°C temperature coefficient; and 5- or 12.5-μsec conversion time. Prices for 5-μsec models range from $47 to $197.50; 12.5-μsec versions cost $35 to $145 (100).

Analog Devices, Literature Ctr, 70 Shawmut Rd, Canton, MA 02021. Phone (617) 935-5565.

Circle No 711

EPLD combines 2000 equivalent logic gates with programmable I/O, feedback circuits



The EP1800 erasable PLD (EPLD) contains enough circuitry to implement more than 2000 equivalent gates of logic. Furthermore, its I/O and feedback circuitry are programmable, providing you with 48 flip-flops that can operate as D, T, JK, or SR types.

The chip circuitry is arranged in 48 macrocells that contain a programmable AND array, feedback lines, and I/O capability. The macrocells have two selectable feedback paths: one that feeds the product term back into the logic array and one that feeds an input presented to an output pin (providing the macrocell's output buffer is disabled) back into the logic array. This dual-feedback feature, not found in other PLDs, helps you use all of the available circuitry on the chip.

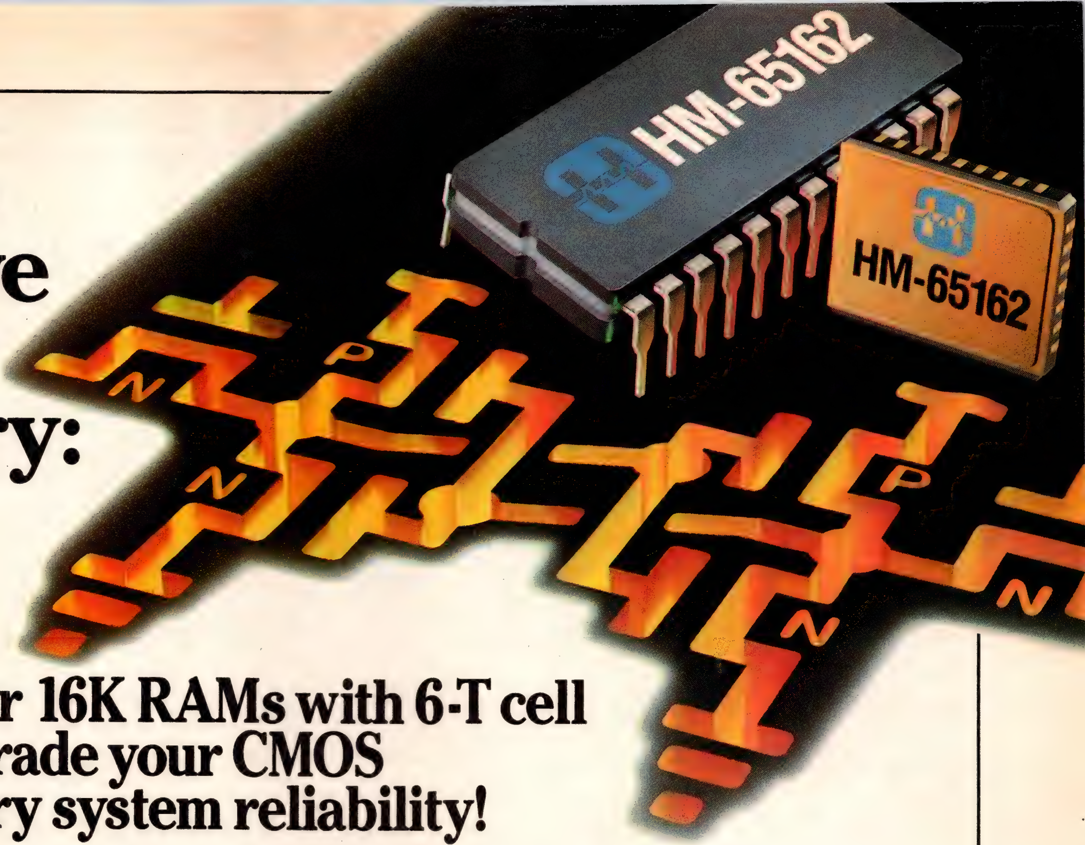
You can configure the EPLD for a maximum of 64 input signals or for a maximum of 48 output signals. Maximum propagation delay from input to output is 50 nsec for the fastest version of the chip. In operating mode, it dissipates 1.2W max; in a quiescent state, it requires only 10 μA.

The chip is built in a sub-2-μm EPROM CMOS technology. One version comes in a ceramic package with a window so you can erase it under an ultraviolet lamp (15 minutes min). Other versions come in lower-cost plastic chip carriers with 68 leads. In a ceramic windowed package, the EP1800 costs $90 (100). The vendor's PLDS2 design software, which runs on an IBM PC, supports design and programming of the device and costs $2500.

Altera Corp, 3525 Monroe St, Santa Clara, CA 95051. Phone (408) 984-2800.

Circle No 713

How to improve your memory:



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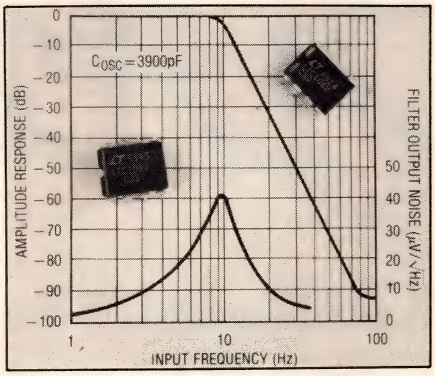
CIRCLE NO 210

Switched-capacitor lowpass-filter IC eliminates dc offset, low-frequency noise

Because its architecture places it outside a system's dc signal path, the LTC1062 switched-capacitor lowpass filter makes no contribution to the system's dc offset voltage and low-frequency noise. The monolithic device is a fifth-order, all-pole, maximally flat filter. The filter uses an internal clock whose frequency you can set by connecting an external capacitor; you can also use an external clock whose frequency is as high as 4 MHz.

In a typical configuration (with an external 100-kHz clock), the LTC1062 demonstrates a clock-to-cutoff frequency ratio equal to 100:1. Frequency response is typically 0.02 dB down at half the cutoff frequency and 30 and 60 dB down at twice and four times the cutoff value, respectively.



The filter works by sampling its own input and output across an external resistor. An external capacitor couples the IC to the signal. The external RC pair reacts with the device's internal switched-capacitor network to provide a fifth-order rolloff at the output. You can connect two LTC1062s in cascade to obtain a tenth-order lowpass filter.

To filter ac signals from high dc voltages, the IC uses a 100-kHz clock frequency and provides a 1-kHz cutoff frequency. The filter accurately passes the signal's dc level and acts as a fifth-order lowpass filter for ac signals riding on the dc signal.

Useful for input frequencies from 0 to 20 kHz, the LTC1062 operates from single or dual power supplies whose total voltage span can range from 5 to 18V. The filter comes in two versions, which cover operating-temperature ranges of −40 to +85°C and −55 to +125°C. Enclosed in an 8-pin plastic or hermetic DIP, the filter IC draws 7 mA max at 25°C and 10 mA max over temperature. LTC1062CN8, $3.55; LTC1062MJ8, $7 (100).

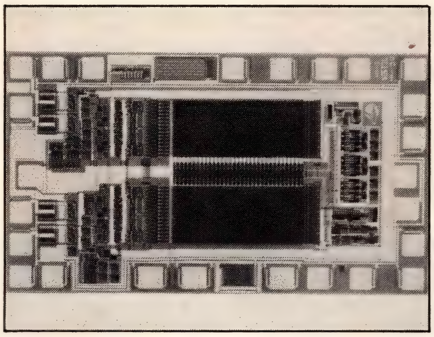
Linear Technology Corp, 1630 McCarthy Blvd, Milpitas, CA 95035. Phone (408) 942-0810.

Circle No 714

4k-bit static RAM uses 0.8-μm process to achieve 15-nsec max access time

The CY7C150 4k-bit static RAM uses a 0.8-μm CMOS technology to achieve a maximum access time of 15 nsec at a maximum current consumption of 120 mA. This RAM is functionally compatible as well as pin compatible with the standard 9150 1024×4-bit static RAM.

The chip has separate I/O pins for data lines; this separation eliminates the delays incurred when using memory chips with multiplexed I/O. Furthermore, the separation makes the chip suitable for applications like cache-tag stores where the output of the device might not connect to a data bus. The CY7C150 also contains a master reset pin that you can assert to reset all memory locations to zero in two clock cycles.



The device comes in a plastic 24-pin DIP or in a cerdip for use over the commercial temperature range. Versions for the military temperature range come in 24-pin cerdips or 28-pin LCCs. You can order the part with a 15-, 25-, or 35-nsec access time. Minimum read and write cycle times for the devices are identical to the access times.

A 15-nsec CY7C150 in a plastic DIP operating over the commercial temperature range costs $29.40; a 25-nsec version costs $18.75 (100). A 25-nsec version housed in a cerdip and processed to MIL-STD-883C Revision C specifications costs $65.05 (100).

Cypress Semiconductor Corp, 3901 N First St, San Jose, CA 95134. Phone (408) 943-2666.

Circle No 722

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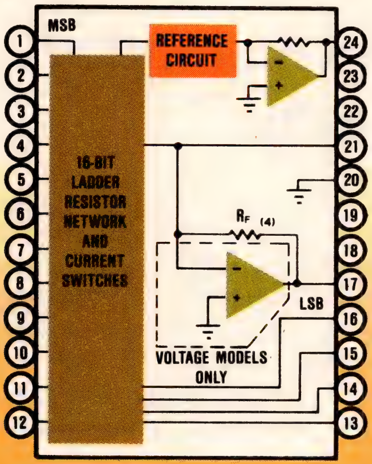

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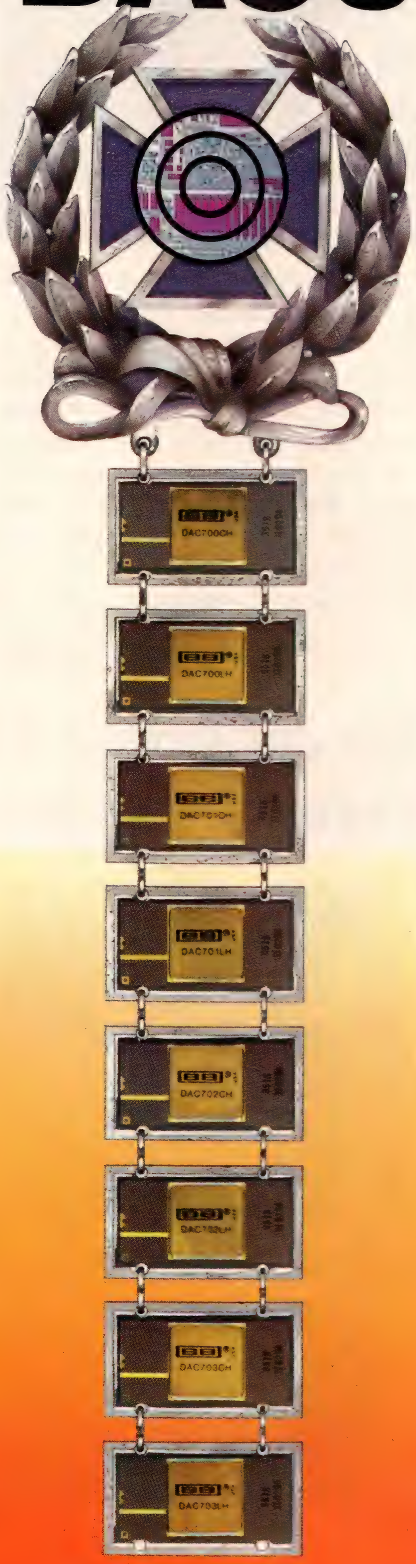
- Packaged in 24-pin ceramic DIPs



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CIRCLE NO 68

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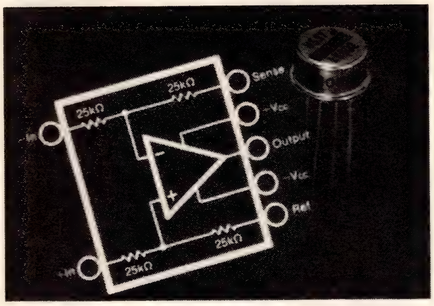
One-chip unity-gain difference amplifier specs 86-dB CMRR and 0.01% gain error

The INA105 monolithic difference amplifier—consisting of an operational amplifier and four resistors—limits worst-case common-mode rejection and gain error to 86 dB and 0.01%, respectively. Nonlinearity is 0.001% max.

Operating from ±15V supplies, the amplifier delivers ±10V min output swing at currents as high as 20 and −5 mA. When the output is short-circuited to ground, current-limiting levels are 40 and −10 mA. Output impedance is typically 10 mΩ. The amplifier remains stable when driving capacitive loads as high as 1000 pF.

Differential and common-mode input impedance is typically 50 kΩ, and the inputs accept differential and common-mode input signals as high as ±10 and ±20V, respectively. Common-mode rejection over the −25 to +85°C operating range is 80 dB min for the INA105AM and 86 dB min for the premium-grade INA105BM. Initial offset voltage is 250 μV max for both grades, and offset drift is 20 and 10 μV/°C max for the -AM and -BM models, respectively.



Typical noise specs are 1.2 μV p-p from 0.01 to 10 Hz and 60 nV/√Hz at 10 kHz. Small-signal and full-power bandwidths are typically 1 MHz and 50 kHz, respectively. The device's output slews at 2V/μsec min and settles a 10V output step to within a ±0.01% error band in 5 μsec typ.

Housed in a TO-99 metal can, the INA105 draws ±2-mA max quiescent current. The unit operates from supplies ranging from ±5 to ±18V. All guaranteed specs are valid only for operation from ±15V supplies. Prices for the INA105AM and INA105BM are $5.75 and $7.20 (100), respectively.

Burr-Brown Corp, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111. TLX 666491.

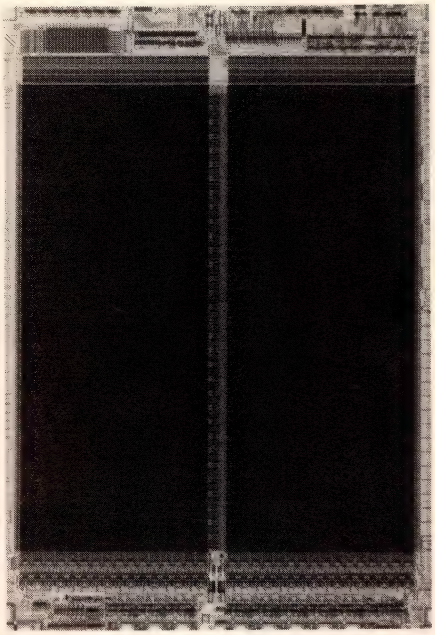
Circle No 715

256k-bit EEPROM consumes 100-μA standby and exhibits a 250-nsec max access time

The 28C256 256k-bit EEPROM draws 60 mA from one 5V source while operating, and it draws only 100 μA in standby. You can access any of the chip's 32k×8-bit words in 250 nsec max.

The company's high-endurance Q-cell design allows the 28C256 to support as many as 1,000,000 write/erase cycles. When you use the part's 64-byte page-write mode, average write time is 160 μsec/byte. In byte-write mode, the chip requires 2.5 msec/byte. To minimize the time required to write data, the 28C256 incorporates a $\overline{\text{DATA}}$-polling mode that indicates the endpoint of a write cycle.

It also offers bulk chip erase, an on-chip timer, and power-up/down protection. Unlike a write operation, where the chip generates its own voltages, chip erase requires a higher voltage than V_{CC}. Power-up/down protection prevents a write operation when V_{CC} is less than 3.8V, and if the write-enable signal hasn't undergone a high-to-low transition when V_{CC} rises above 3.8V.



The pinout of the chip conforms to JEDEC standards for byte-wide memory ICs. Operation is over the commercial temperature range. Samples of the 28C256 are available in cerdips and LCCs. $195 (100).

Seeq Technology Inc, 1849 Fortune Dr, San Jose, CA 95131. Phone (408) 942-1990.

Circle No 723

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PM-7528 *Latched Dual 8-Bit*	*1/2*		*1*	
PM-7533 *Multiplying 8-Bit*	*1*		*2*	
PM-7541 *Multiplying 12-Bit*	*1*		*1*	
PM-7541A *Multiplying 12-Bit*	*1/2*		*1*	
PM-7545 *Latched 12-Bit*	*1/2*		*2*	
PM-7645 *Latched 12-Bit*	*1/2*		*Not Available*	
DAC-8012 *Readback 12-Bit*	*1*		*Not Available*	
DAC-8408 *Readback Quad 8-Bit*	*1/2*		*Not Available*	
DAC-8212 *Latched Dual 12-Bit*	*1*		*Not Available*	

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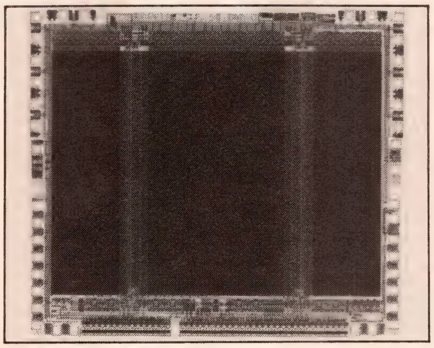
CIRCLE NO 69

1M-bit EPROM offers two low-power modes and an interface to 16-, 32-bit μPs



The Am27C1024 1M-bit EPROM has two low-power modes and a 16-bit interface suitable for use with 16- and 32-bit μPs. When active, the chip dissipates 250 mW; in standby mode, it dissipates 5 mW. Futhermore, you can disable a chip-enable interrupt line, forcing the chip into a power-down mode in which it dissipates only 1 mW.

The EPROM can access 16-bit data in 200 nsec. You can program the device in less than two minutes using the vendor's interactive programming algorithm. You can program memory locations singly, in blocks, or at random.

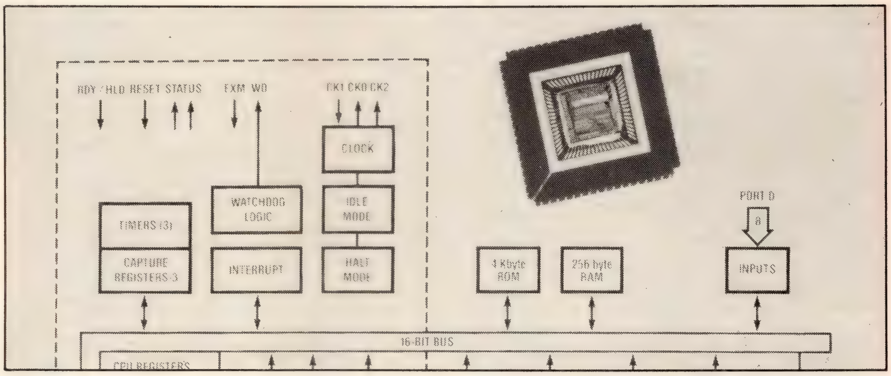
To program the device, you apply 11.5±0.3V to the V_{PP} pin and low voltages to $\overline{W}$ and $\overline{E}$. The interactive programming algorithm verifies data as it is written to reduce the number of programming pulses required. To erase the device, you expose it to 2537Å ultraviolet light for 20 minutes.

The device comes in a 40-pin side-brazed package (DIP or leadless chip carrier). You can order it specified for commercial, industrial, or military temperature ranges and for ±5 or ±10% power-supply tolerance. $199.

Advanced Micro Devices Inc, Box 3453, Sunnyvale, CA 94088. Phone (408) 732-2400.

Circle No 716

16-bit CMOS microcontroller offers 240-nsec cycle time and 17-MHz clock



The HPC16040 is the first of a family of 16-bit microcontrollers built around a 17-MHz core processor. This member of the family (as will other members) comprises a core processor and peripheral, I/O, and memory circuits that together implement an instruction-cycle time of 240 nsec.

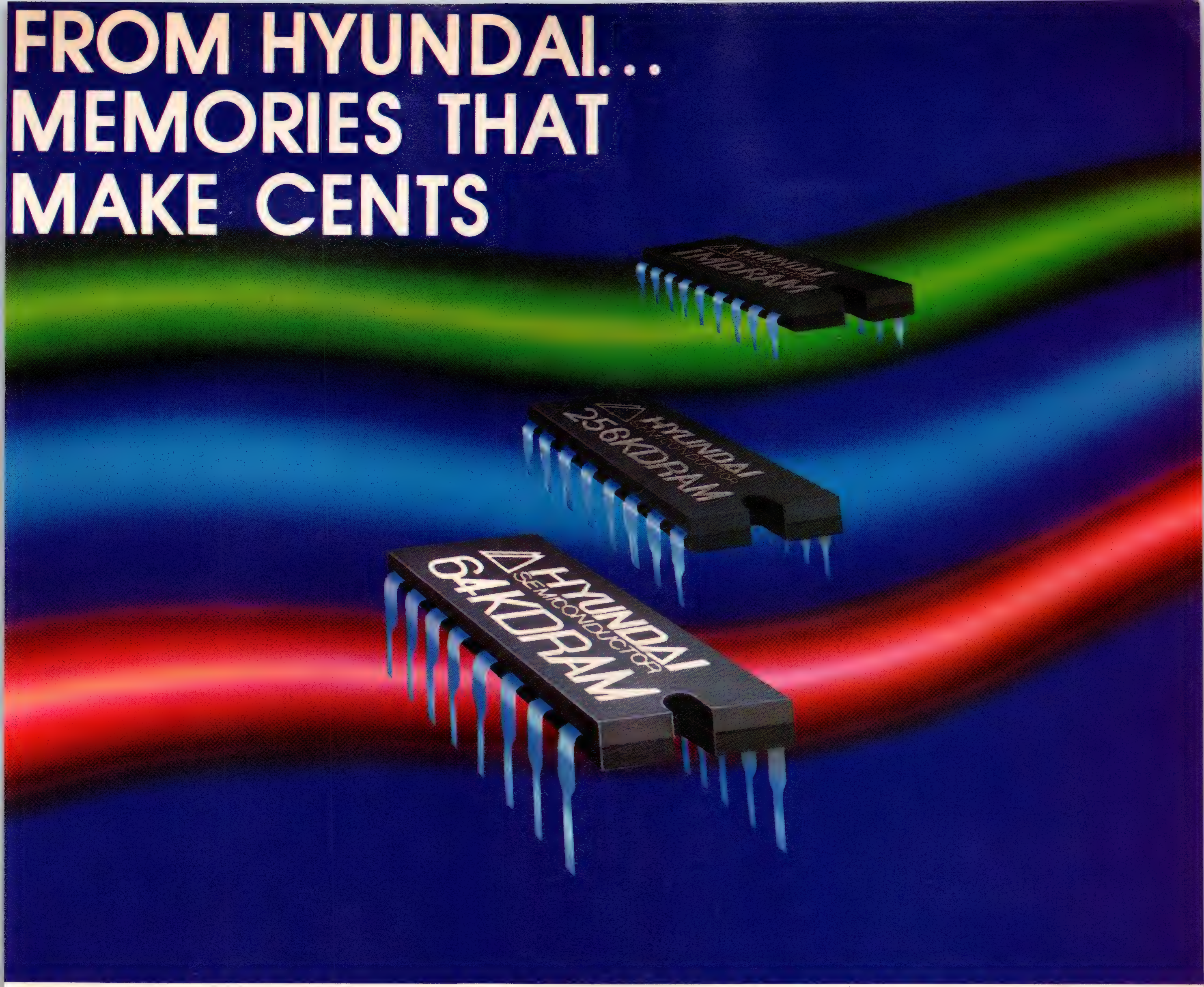
The core processor contains a 16-bit CPU with six working registers, a microinstruction ROM, 16-bit data paths, three 16-bit counter/timers, watchdog circuitry, and a clock generator. The chip contains three pins that implement the vendor's Microwire/Plus synchronous serial interface, which connects directly to other Microwire peripherals such as A/D converters, EEPROMs, and display drivers.

The HPC16040 adds memory and I/O circuitry to the core processor. It contains 4k bytes of ROM and 256 bytes of RAM. Eight 16-bit timers (including four PWM timer registers) and a UART complete the chip. The microcontroller has two low-power modes (idle and halt) that reduce current consumption from a maximum of 20 mA to 2 mA and 25 μA, respectively. A timer reset or an interrupt brings the chip back from the low-power modes to full operation.

The vendor provides a development package that includes emulation and debugging software, an assembler/disassembler, and a development board. Software in the package runs on various hosts, including personal computers. A ROM-less version of the HPC16040 is available now for development; it comes in a 68-pin plastic LCC for $29.90 in sample quantities.

National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051. Phone (408) 721-5000. TWX 910-339-9240.

Circle No 718



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CIRCLE NO 183

HYUNDAI CMOS MEMORIES

V	PRODUCT	PART NO.	ORGANIZATION	ACCESS TIME (ns)	Vcc	SUPPLY CURRENT (Max.)		PIN NO.
						ACTIVE	STAND BY	
	16K SRAM	HY61C16/L	2K x 8 BIT	45,55,70	+5V	100mA	100uA	24
		HY6116/L	2K x 8 BIT	100,120,150	+5V	100mA	100uA	24
		HY61C16A/AL	2K x 8 BIT	35,45,55	+5V	100mA	100uA	24
		HY61C67/L	16K x 1 BIT	35,45,55	+5V	50mA	100uA	20
		HY61C68/L	4K x 4 BIT	35,45,55	+5V	60mA	100uA	20
		HY61C69/L	4K x 4 BIT	35,45,55	+5V	60mA	100uA	22
	64K SRAM	HY6264	8K x 8 BIT	45,55,70	+5V	100mA	10mA	28
	64K DRAM	HY51C64/L	64K x 1 BIT	100,120,150	+5V	37mA	1.5mA	16
	256K DRAM	HY51C256L	256K x 1 BIT	100,120,150,200	+5V	55mA	2mA	16
	64K EPROM	HY27C64	8K x 8 BIT	150,200,300	+5V	30mA	100uA	28
	1K EEPROM	HY93C46	64 x 16 BIT	250KHz	+5V	4mA	400uA	8
	PEEL	HY18CV8	–	25/15	+5V	25mA	15mA	20

I want to know more about Hyundai memories. Please send me the data sheets I have checked above.

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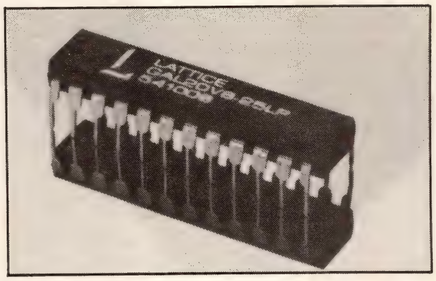
Electrically erasable array replaces 24-pin PLDs, draws 50% less current



The GAL 20V8 PLD can substitute for a variety of 24-pin PLDs, but it draws roughly half the current that the traditional PLDs use. The device has a 25-nsec propagation delay. In addition, the GAL 20V8's outputs can sink 24 mA, as can many bipolar parts.

Like its predecessor, the 20-pin GAL 16V8, this device is electrically erasable and reprogrammable. You can program the part on PLD programmers from Data I/O Corp (Redmond, WA) and Stag Microsystems Inc (Sunnyvale, CA).

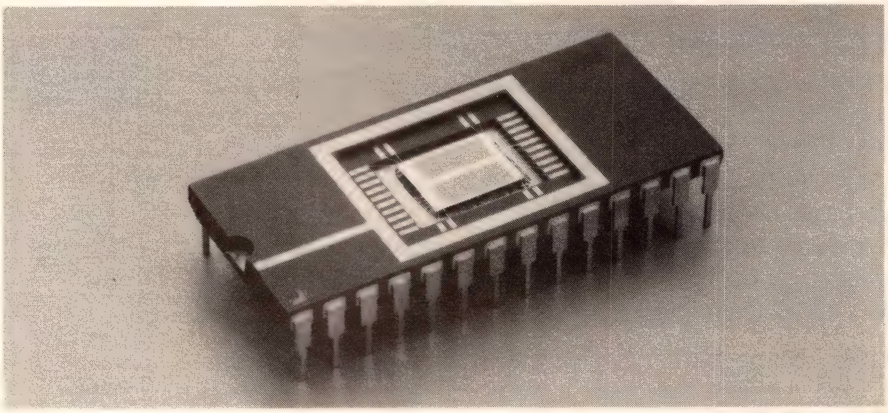
Both the GAL 16V8 and the GAL 20V8 have programmable macrocells that drive their outputs. The PLD programmers contain programming patterns that specify the macrocell configurations for emulating a particular type of device. The GAL 20V8 can replace such devices as the 14L8, 16L6, 18L4, 20L2, 20L8, 20R8, 20R6, and 20R4. You can implement registered devices like the 20R4 because the macrocells are programmed to implement a register at four of the outputs.

Because the GALs can be erased and reprogrammed, the manufacturer can test them before shipment and guarantee 100% functionality and 100% programming yield. Using standard PLD programming tools such as Abel, CUPL, and PALASM, you can create a design. The GAL 20V8 comes in a 300-mil plastic package. 25-nsec version, $17.63; 35-nsec version, $13.26 (100).

Lattice Semiconductor Corp, 15400 NW Greenbrier Parkway, Beaverton, OR 97006. Phone (503) 629-2131.

Circle No 717

256k-bit EEPROM specs 150-nsec access time and incorporates data-protection feature



You can access any byte in the X28256 256k-bit EEPROM in 150 nsec typ. In addition, by executing a sequence of three write operations, you can prevent any additional writing to the chip, thereby protecting the data you've already stored. The chip-enable and address access times are equal to the read cycle time—ie, 150 nsec typ.

The chip is organized in 32k bytes; you read and write data through an 8-bit I/O port. You can use a 64-byte page-write operation during programming, which results, in effect, in a 78-μsec/byte programming time. The page-write operation also allows you to program the entire chip in 2.5 sec. Alternatively, you can program the chip byte by byte. To help minimize programming time, the X28256 provides a $\overline{\text{DATA}}$-polling feature that indicates when a write operation is successful.

The part comes in a 28-pin package that has the same I/O pinout as 64k-bit EEPROMs. The chip uses an NMOS technology that requires only a 5V power supply; the chip generates the programming voltages. It consumes 100 mA typ when active and 50 mA typ when idle. The EEPROM operates from 0 to 70°C and from a 5V±5% supply. Samples of the X28256 cost $120 (100); the vendor plans to have the part in limited production by September.

Xicor Inc, 851 Buckeye Ct, Milpitas, CA 95035. Phone (408) 946-6920. TWX 910-379-0033.

Circle No 720

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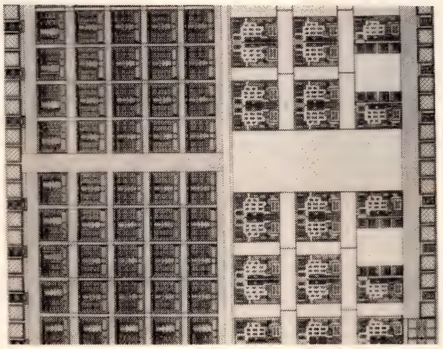
Linear/digital array IC combines 6.5-GHz transistors and 500-MHz gates

The Quickchip 4 comprises both 500-MHz digital circuitry and linear components, including npn transistors having the highest gain-bandwidth product f_T of any array—6.5 GHz. Linear components include 294 npn transistors, 174 pnp transistors, 1290 implanted resistors, and 16 programmable capacitors with values as high as 2.7 pF.

The vendor can fabricate on-chip nichrome resistors that exhibit a 12% tolerance (at 25°C) and a temperature coefficient of 125 ppm/°C max. All resistor values match to within 1%; on-chip laser trimming is available to achieve tolerance and matching specs as low as 0.01%.

The digital section of the chip consists of 32 ECL circuit blocks that can implement one or two SSI logic cells, multiplexers, decoders, latches, or flip-flops. Typical propagation time ranges from 400 psec for the SSI logic to 1.1 nsec for a 2-bit full adder. The ECL logic requires a −5.2V±5% supply.



The chip can interact with circuitry at TTL signal levels, with 10K ECL circuits (over the commercial temperature range), and with 100K ECL circuits over a more restricted temperature range. The chip contains 66 contact pads, of which 10 must connect to voltage supplies.

The company uses a design system for the chip that includes the TLOGS simulator for functional, timing, and testability analysis, the TSpice circuit simulator for analog simulation, and Quickic layout software. The design system runs under VMS or Unix.

Quickchip 4 wafers are available three weeks after you approve the final design; packaging the parts takes an extra few days. NRE charges depend on the complexity of the design; fabrication of prototypes costs $26,500.

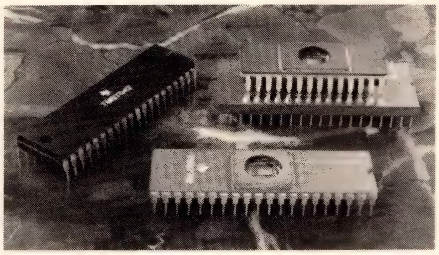
Tektronix Inc, Integrated Circuits Operation, Box 500, MS 59-420, Beaverton, OR 97077. Phone (503) 627-2515.

Circle No 724

8-bit single-chip μC has on-chip EPROM for prototyping and development

The TMS7742, an 8-bit single-chip microcomputer, incorporates a 4k-byte on-chip EPROM to facilitate prototyping and development. The chip puts a standard 2732 EPROM design into the silicon area that would normally contain a masked ROM. To program the TMS7742, you can use a standard PROM programmer and a 40- to 24-pin adapter socket with the $\overline{\text{Reset}}$ and XTAL2 pins grounded.

In addition to its EPROM, the TMS7742 has 256 bytes of RAM, a serial-I/O port, two 13-bit timers, and one 10-bit timer that you can use as a baud-rate generator. To reduce software overhead and shorten the interrupt-response time, the chip's register-to-register architecture lets you use the RAM locations as registers. Consequently, this chip doesn't require an accumulator for direct-register arithmetic and logical operation. Clock frequency ranges from 1 to 5 MHz.



The TMS7742 has 32 TTL-compatible I/O pins: 22 bidirectional pins, eight output pins, and two input pins. Using Intel or Motorola multiprocessor communication formats, the chip's serial port can communicate with multiple devices in asynchronous, isosynchronous, or serial-I/O mode. The serial port operates at a maximum baud rate of 625k bps in the isosynchronous or serial-I/O modes and 78k bps in the asynchronous mode.

Housed in a 40-pin ceramic side-brazed package, the TMS7742 dissipates an average of 900 mW and operates over 0 to 70°C. $38.40 (100).

Texas Instruments Inc, Semiconductor Group (SC-517), Box 809066, Dallas, TX 75380. Phone (800) 232-3200.

Circle No 721

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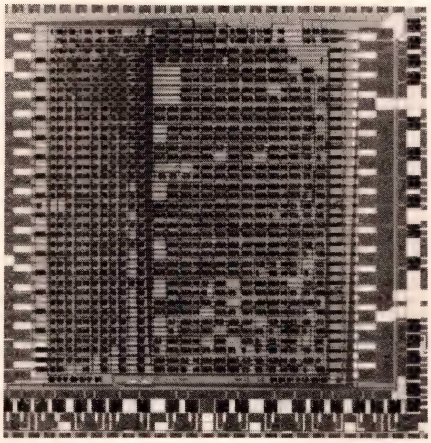
CIRCLE NO 100

ECL chip multiplies two 16-bit integers in 5 nsec but dissipates only 2.9W typ



The B3018 completes a 16×16 multiplication in 5 nsec typ (8 nsec max). Even though the part uses power-consuming ECL technology (making it compatible with 10KH signal levels), it dissipates only 2.9W typ (4.5W max).

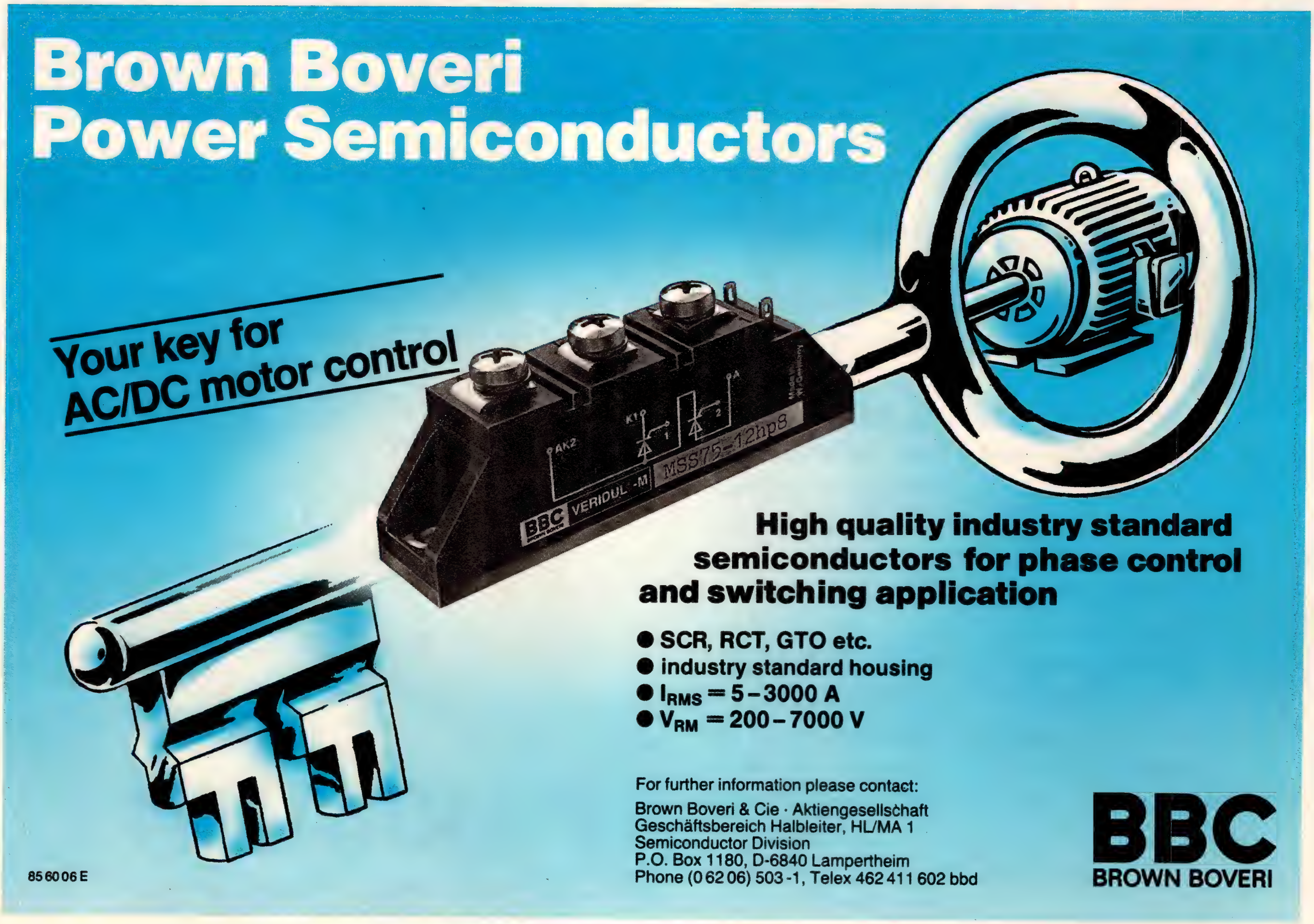
You can force this fixed-point multiplier to operate on unsigned, signed, and mixed-mode numbers. The chip provides the data in its 32-bit result in parallel. However, internal control circuits let you access the most significant and least significant words individually.

Inputs and outputs have latches and enable signals, but you can implement asynchronous multiplication by leaving clock and enable signals asserted. Loading operands directly into the output latches (without performing mutliplication) permits format adjustment, rounding, and output-status setting.

You can force the chip to round off the multiplier's result. Alternatively, the chip can maintain either a signed-fractional or a maximum-precision output format. Three status flags indicate zero, negative, and overflow results; you read the status of the flags through three output pins. The B3018 comes in a 108-pin pin-grid-array package for $260 (100).

Bipolar Integrated Technology Inc, 1050 NW Compton Dr, Beaverton, OR 97006. Phone (503) 629-5490.

Circle No 719



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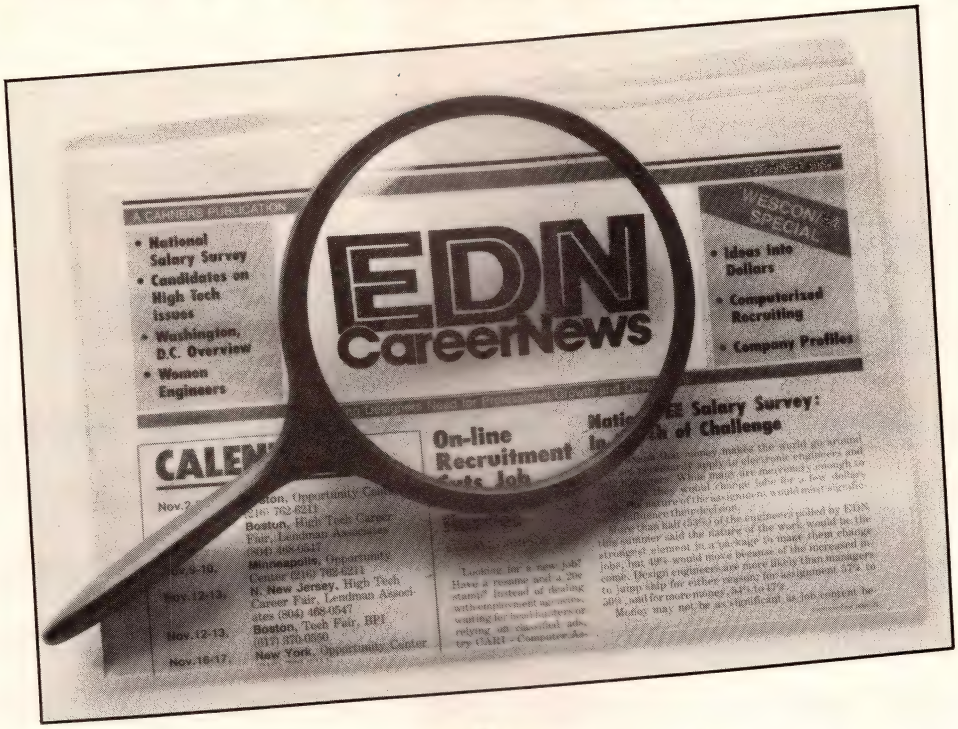

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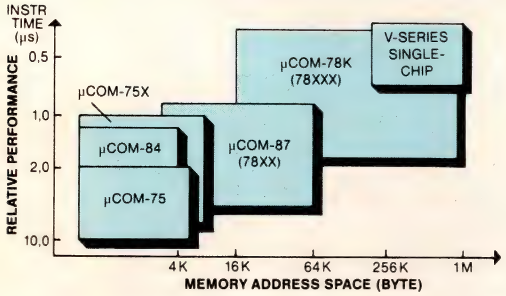

A single-chip device with a cycle time of 0.5 µs, it bridges the gap between NEC's 8-bit µCOM-87 products and the V25 microcomputer. Memory capacity on-chip is 8 Kbyte ROM and 256 byte RAM, with 64 Kbyte of external memory possible.

The µPD78312 features a true 16-bit CPU and bus architecture, plus dedicated hardware blocks for streamlining real-time control applications. Enhanced interrupt capabilities include interrupt service handling, context switching, and a macro service facility. Specially designed for

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control applications, the instruction set is ideal for high-speed arithmetic and logic operations.

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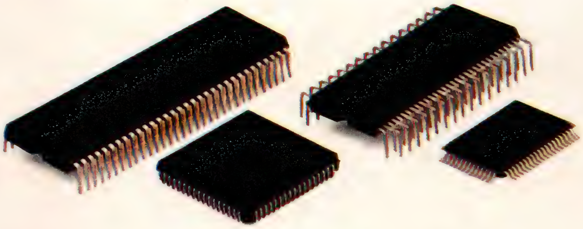

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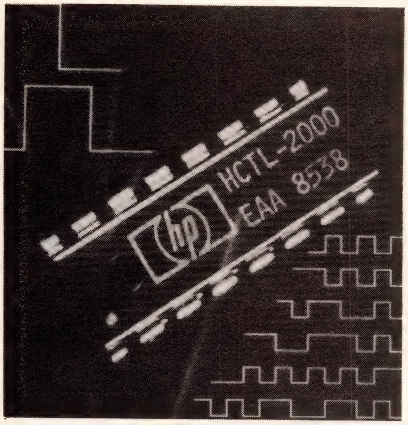


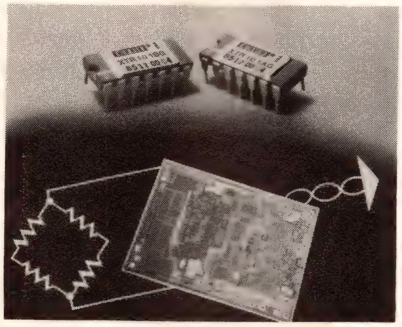
MOTION-CONTROL ICs

The NMOS HCTL-2000 is a quadrature-decoder and counter-interface device for motion-control circuits. The HCTL-1000 dedicated CMOS µP performs all motion-control functions required in high-performance servo loops. Model HCTL-2000 accepts digitally encoded quadrature signals from an optical shaft encoder or digital potentiometer and converts the signals to µP-compatible signals. The unit contains a digital input-noise filter; a quadrature decoder; a 12-bit binary counter with latched outputs; a multiplexed, 8-bit parallel-output port; and an interface-control logic section.

The HCTL-1000 provides position and velocity control to motors by comparing the command position from the host processor with the actual position feedback from an incremental encoder. An 8-bit, multiplexed bidirectional address/data bus provides the interface to the host processor. The -2000 comes in a 16-pin single DIP and operates over −40 to +85°C; the -1000 occupies a 40-pin double DIP and operates over 0 to 70°C. The CMOS part dissipates 300 µW typ; the NMOS device consumes 400 mW typ, 950 mW max. The HCTL-2000 and -1000 cost $8.50 (100) and $28.25 (250), respectively.

Hewlett-Packard Co, Inquiries Manager, 1820 Embarcadero Rd, Palo Alto, CA 94303. Phone local office.

Circle No 669



TRANSMITTER

Designed for transmitting sensor-generated and other low-level signals through electrically noisy industrial environments, Model XTR101 4- to 20-mA transmitter transmits data over—and receives its power from—a single wire pair. The 2-wire device performs its function by modulating its power-supply current according to the input-signal source. The transmitter is immune to voltage drops stemming from long power-supply runs; it also ignores noise from industrial equipment, such as motors, relays, actuators, switches, and transformers.

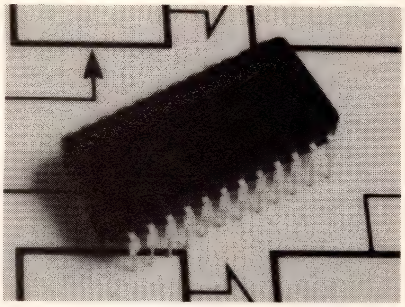
The XTR101 contains an input instrumentation amplifier that specs ±0.01% max nonlinearity. The IC also has a voltage-controlled output-current source and two matched 1-mA current sources. The transmitter comes in a 14-pin metal or ceramic DIP, and it operates over −40 to +85°C. A voltage range of 0 to 1V at the input of the instrumentation amp causes currents of 4 to 20 mA to circulate in the 2-wire output loop. The XTR101 accommodates power-supply voltages from 11.6 to 40V. Price is $8.25 or $12.25 (100), depending on grade.

Burr-Brown Corp, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111. TWX 910-952-1111.

Circle No 670

D/A CONVERTER

Containing two matched CMOS multiplying D/A converters on one chip, Model DAC-8212 offers 12-bit monotonicity and ±½-LSB integral linearity over each of three available temperature ranges. The device, which comes in a 24-pin hermetic or plastic double DIP, has a 12-bit input buffer and two 12-bit latches that drive the internal D/A converters. The word-wide input path lets you update both D/A converters in two processor instructions.



Offering 4-quadrant multiplication, the converter operates from one 5 to 15V supply. The part is available in two accuracy grades, whose respective maximum full-scale gain errors are ±1 and ±6 LSB at 25°C and ±2 and ±7 LSB over temperature. Worst-case supply current consumed by the DAC-8212 is 2 mA, and worst-case power-supply rejection is 0.02%/% at 25°C and 0.04%/% over temperature. Output-current settling time to within ±½ LSB of full-scale value is 2 µsec. Input-to-output propagation delay is 220 nsec max. $15.26 to $72.20 (100).

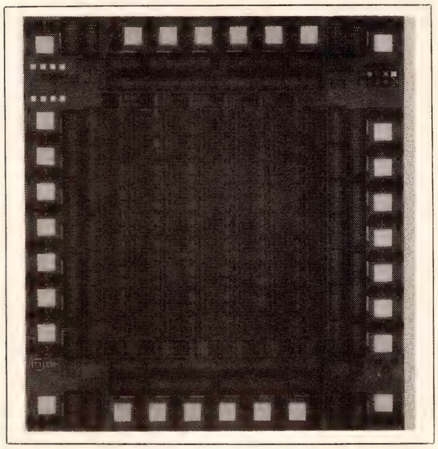
Precision Monolithics Inc, Box 58020, Santa Clara, CA 95052. Phone (408) 727-9222. TWX 910-338-0218.

Circle No 671

CMOS ARRAYS

Series MH silicon-gate CMOS arrays operate with supply-voltage levels as high as 18V. The series consists of eight linear/digital arrays that vary in complexity from 70 to 1600 equivalent 2-input gates and 18 to 84 I/O pads.

Although the vendor includes no analog cells in its function library, you can build such linear circuits as current mirrors, op amps, and D/A converters from the transistors on



the periphery of the arrays. The vendor currently supplies a library of digital macro functions (cells) for logic and circuit design on Mentor and Futurenet workstations. The library contains 50 functions modeled after standard Series 4000 CMOS parts. Turnaround time for prototypes, including layout, is six to 16 weeks.

The vendor packages the arrays in DIPs, small-outline packages, surface-mount carriers, chip carriers, and pin-grid arrays. Nonrecurring engineering charges start at $5000, and unit prices start at $1 (for 10,000 MHA arrays in 14-pin plastic DIPs).

Ferranti Interdesign Inc, 1500 Green Hills Rd, Scotts Valley, CA 95066. Phone (408) 438-2900.

Circle No 672

STANDARD CELLS

A line of electrically erasable standard memory cells lets you create a custom IC that includes nonvolatile memory. These cells are compatible with the manufacturer's digital and analog standard cells, so you can integrate linear and memory functions with digital logic. The memory cells have parallel data-storage bits for redundancy (ie, each memory cell stores its data on two separate transistors), thereby increasing the IC's effective yield. Differential sensing allows the chip's overall supply voltage to vary between 3 and 6V. The cells have the typical endurance specifications for electrically erasable devices—10,000 cycles and 10-year data retention.

The company also offers high-voltage generator and interface cells that provide the voltages and programming signals required to write data. Each memory cell is embedded in a digital flip-flop and latch so it can operate directly with other on-chip logic. To create your chip using the electrically erasable cells, you submit your system design and specifications to the manufacturer, which charges between $5000 and $25,000 for the design (depending on its complexity) and about $30,000 for the tooling and fabrication of prototypes. The unit cost of production devices is $0.0015/gate typ.

Sierra Semiconductor Corp, 2075 N Capitol Ave, San Jose, CA 95132. Phone (408) 263-9300.

Circle No 677

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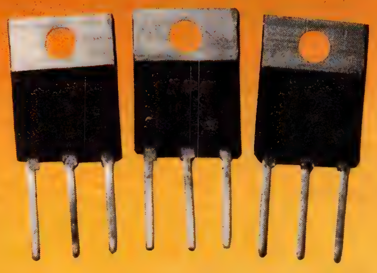

BIPOLAR OP AMPS

The HA-5151, -5152, and -5154 single, dual, and quad op amps (respectively) are drop-in compatible with the DIP-packaged TL061/62/64 JFET-input devices, except that the HA-5151 lacks the offset-null pins found in the TL061. Minimum slew rate is 2V/µsec for both families; typical slew rate, however, is 4.5V/µsec for the HA devices and 3.5V/µsec for the TL parts. As a result, the HA devices have a 1.3-MHz typ gain-bandwidth product, which is 30% higher than the TL units' 1 MHz typ.

Although the HA and TL devices draw the same 250-µA max supply current, the open-loop gain for the HA units is 50,000 min at 25°C and 25,000 min over temperature (0 to 75°C or −55 to +125°C, depending on version). By contrast, the TL devices spec gain of 4000 min both at 25°C and over temperature. Models HA-5151 and HA-5152 single and dual op amps are available in metal cans or 8-pin DIPs. The quad HA-5154 comes in a 14-pin DIP; both the dual and quad units are also available in 20-pad LCCs. Single op amps, $1.42 to $7.69 (100); dual amplifiers, $2.92 to $20.20; quad devices, $4.66 to $28.80 (100).

Harris Corp, Box 883, Melbourne, FL 32901. Phone (305) 724-7418.

Circle No 673

GaAs RIPPLE COUNTER

The TQ1111 family of 4-bit ripple counters is available in versions that accommodate 2-, 2.5-, and 3-GHz clock frequencies (Models TQ1111-20, -25, and -30, respectively). The counters use cells from the manufacturer's standard-cell library of depletion-mode GaAs devices.

Providing full compatibility with 10K and 100K ECL circuits, the TQ1111 units spec −1 to −1.1V logic-high input levels and −1.5 to −1.6 logic-low levels. Both the positive and negative supplies can vary over the absolute range of 4 to 5.2V. Each divider stage provides an ECL-compatible output; the first divide-by-2 stage also provides a complementary output. The ac-coupled clock input requires 1V p-p min drive for the 2- and 2.5-GHz devices and 2V p-p min for the 3-GHz selection. Delay from clock edge to each output of the divide-by-2 counter is 700 psec.

Packaged in a 10-pin metal-ceramic flat pack, the parts operate over 0 to 85°C. Prices for the 3-, 2.5-, and 2-GHz counters are $199,

Continued on pg 117

Outside!

What would you do if someone put high-current voltage regulators in a low-cost plastic power package?

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Device	Package	Output
IP323AV-5	TO-218	+5V, ±1%, 3 amp
IP323AV-12	TO-218	+12V, ±1%, 3 amp
IP323AV-15	TO-218	+15V, ±1%, 3 amp
IP338AV	TO-218	+1.25V to 35V, ±1%, 5 amp
IP350AV	TO-218	+1.25V to 35V, ±1%, 3 amp

CIRCLE NO 121

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TURN TO PAGE 297

DIGITAL FITNESS

You'll find the perfect fit in our DTS family.

Tune-up your system with powerful 4-bit CMOS single-chip microcomputers from NEC. Our DTS chips incorporate PLL frequency synthesizers, controllers and display circuits. Even prescalers for radio tuning.

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TV/CATV
The µPD1709ACT offers precise tuning of 139 TV/CATV channels. Attractive features include ten-key tuning, channel display on-screen or via LEDs, and precision AFT.

VCR
The economical µPD1716CT gives you all the tuning functions above without the display features. You save by letting the CPU in the VCR handle displays.

Car Stereo
Minimize component count with the µPD1713AG. Incorporating a 150MHz FM band prescaler and IF counter, it helps you design a smaller system to win a larger share of the automotive market.

Portable Radio
The µPD1706G features 3V operation and plenty of I/O ports.

Home Stereo
For audio excellence, the µPD1714G delivers low-noise reception via an on-chip 150MHz FM band prescaler. Plus large-capacity ROM and RAM, AD converter, and IF counter for easy station identification.

Part No.	µPD1709ACT	µPD1716CT	µPD1714G	µPD1713AG	µPD1706G
Application	TV/CATV	VCR	Home stereo	Car stereo	Portable radio
Power consumption (µA)	600	500	500	400	85
ROM (Bits × steps)	16 × 1,526	16 × 1,024	16 × 2,040	16 × 1,528	16 × 1,148
RAM (Bits × words)	4 × 64	4 × 64	4 × 128	4 × 96	4 × 80
Instructions	82	81	94	79	70
Display	LED	—	LCD	LCD	LCD
Input port	—	—	4	4	5
I/O port	6 + 4 (out) Serial I/O	8 + 5 (out) Serial I/O	8 + 12 (out) Serial I/O	4 + 7 (out)	4 + 16 (out)
A/D Converter	1 + 1	1	1	—	—

For further information, please contact:

■ USA

NEC Electronics Inc.
Tel: 415-960-6000. TWX: 910-379-6985

■ Europe

NEC Electronics (Germany) GmbH
Tel:0211-650302. Telex:8589960 NE D.

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INMOS Corporation, Colorado Springs, Colorado. Tel. (303) 630-4000 Bristol, England. Tel. 0272-290-861 Paris, France. Tel. (1) 687-2201 Munich, Germany. Tel. (089) 319-1028

Device	Access Times	Max Power (mW) act	stby	Process
IMS1400 16K x 1	35,45,55	660	110	NMOS
IMS1420 4K x 4	45,55	605	165	NMOS
IMS1423 4K x 4	25,35,45	660	33 CMOS	CMOS
IMS1600 64K x 1	45,55,70	440	77 CMOS	CMOS
IMS1620 16K x 4	45,55,70	440	77 CMOS	CMOS

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CIRCLE NO 112

$119, and $89 (100), respectively. An evaluation board for the 3-GHz device costs $275.

Tri-Quint Semiconductor Inc, Box 4935, Beaverton, OR 97075. Phone (503) 629-4227.

Circle No 675

OPTOCOUPLERS

The 74OL6000 Series optocouplers provide an interface between LSTTL and TTL or CMOS circuitry. The parts are available in buffer or inverter configurations, and they accommodate data-communication rates as high as 15M bps. The parts' input stage provides LSTTL compatibility. The output stage for the LSTTL-to-TTL units uses the classic totem-pole configuration to provide a fanout of 15 TTL loads. For the LSTTL-to-CMOS units, an open-collector output accommodates power-supply voltages between 4.5 and 15V.

The ICs' input stage switches a temperature-compensated current source that drives a high-speed GaAsP/GaAs LED emitter. This emitter is optically coupled to an integrated photodetector that drives an output-amplifier IC. The devices' optically transparent noise shield provides 15-kV/µsec common-mode noise rejection. The optocoupler family specs typical propagation delays of 60 nsec. The ICs are housed in 6-pin DIPs. $2.55 (1000).

General Instrument, Optoelectronics Div, 3400 Hillview Ave, Palo Alto, CA 94304. Phone (415) 493-0400.

Circle No 674

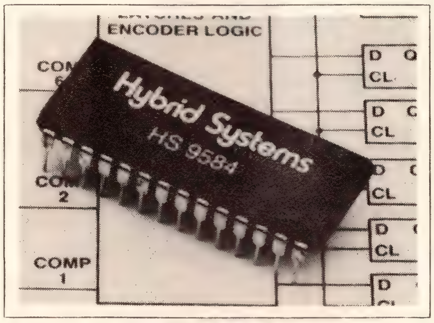
DUAL COMPARATORS

The LT1017/1018 Series dual comparators offer you a tradeoff between low operating power (LT1017) and high speed (LT1018). The LT1017, which is optimized for low power dissipation, draws 60-µA max supply current; the LT1018, optimized for high speed, draws 250 µA max. For input signals providing 2-mV overdrive, delay time for the LT1017 is approximately 30 µsec for the signal's rising edge and 45 µsec for the falling edge. Under the same condition, respective delays for the LT1018 are approximately 9 and 10 nsec.

Voltage gain for both the LT1017 and LT1018 is 110 dB min. Offset voltage for both models is 1 mV max, and their CMRR ratio is 105 dB min. Available in either 8-pin metal cans or in plastic DIPs, the LT1017 and LT1018 cost $2.10 and $1.95 (100), respectively.

Linear Technology Corp, 1630 McCarthy Blvd, Milpitas, CA 95035. Phone (408) 942-0810.

Circle No 676

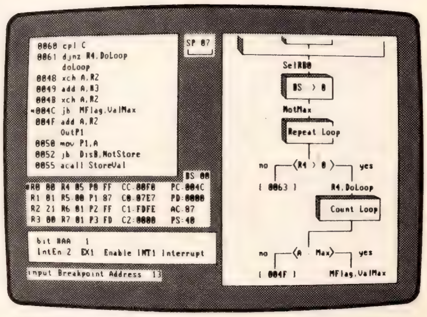


A/D CONVERTERS

Three CMOS flash A/D converters require only one 3 to 8V supply for operation. The monolithic devices come in commercial or MIL-STD-883C versions and feature sampling rates from 5 to 30 MHz and power consumption no higher than 300 mW. The 6-bit HS9582 parallel flash converter is specified for 15-, 25-, or 30-MHz sampling rates; corresponding power consumption ranges from 50 to 200 mW. Linearity error is ±¼ LSB at 15 MHz with a 5 or 8V supply. An overflow bit lets you achieve higher resolution by connecting two converters in series.

The 8-bit HS9583 is a 2-step flash device that converts the first three MSBs in one pass, and then converts the remaining five LSBs in a second pass. Offering 5- or 10-MHz sampling rates and 75-mW power consumption, it features ±¼ LSB

IBM-PC based microcomputer development tools!



```
 0060 cpl C
 0061 djnz R4,DoLoop
      doLoop
 0048 xch A,R2
 0049 add A,R3
 004B xch A,R2
*004C jb  MFlag,ValMax
 004F add A,R2
      OutP1
 0050 mov P1,A
 0052 jb  DisB,NotStore
 0055 acall StoreVal

*R0 00 R4 05 P0 FF  CC-00F0  PC-004C
 R1 01 R5 00 P1 87  C0-07E7  PD:0000
 R2 21 R6 01 P2 FF  C1-FDFE  AC-07
 R3 00 R7 01 P3 FD  C2:0000  PS:40

 bit #AA    1
 IntEn 2  EX1  Enable INT1 Interrupt

Input Breakpoint Address  13
```

(8051 debug/simulator shown)

Your IBM PC can Assemble, debug and program (EPROM) code for these popular microcomputers:

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8088	✓		✓
8085		✓	✓
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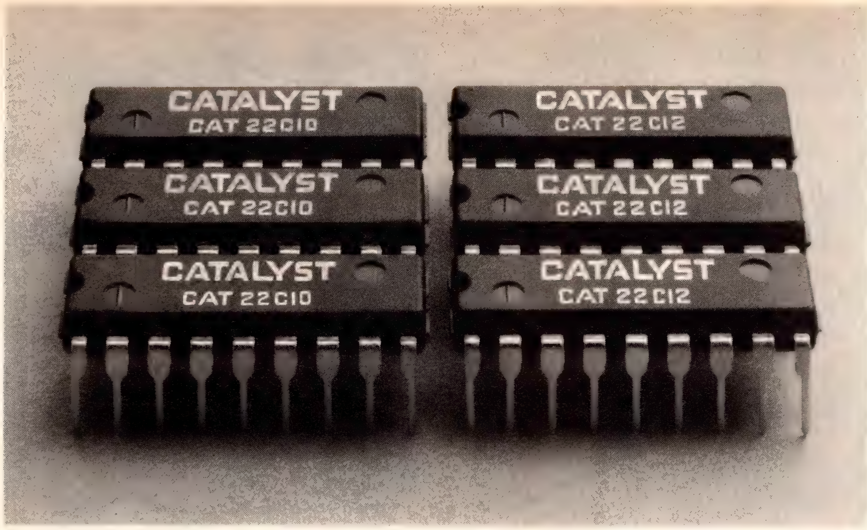

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The CAT22C10 NVRAM is a 256-bit device organized 64 x 4. Full static CMOS circuitry uses 40 mA in the active mode and standby current of 30 uA. Model CAT22C12, a 1024-bit device organized 256 x 4 uses 50 mA active current and 30 uA standby.

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Single power supply (5V ± 10%). 3-state output. 200ns/min short store and 300ns/min recall pulses. False store protection below 3.5V. 10,000 nonvolatile Store cycles per bit.

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CATALYST
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CIRCLE NO 159

linearity at 5 MHz with a 5 or 8V supply. The full-flash HS9584 comes in a 28-pin DIP and contains 255 clocked comparators. Offering 10- and 20-MHz sampling rates, this converter specs a 60-psec aperture uncertainty, which permits the conversion of full-amplitude signals with frequencies as high as the Nyquist limit. The HS9582 costs $15.40 to $89 (100). Housed in a 24-pin DIP, the HS9583 costs $44.30 to $161. The HS9584 costs $55.40 to $248 (100).

Hybrid Systems Corp, 22 Linnell Circle, Billerica, MA 01821. Phone (617) 667-8700.

Circle No 680

IBM PC/AT ICs

The FE2010 and the FE3000 reduce the board size and cost, lower the power requirements, and increase the reliability of IBM PC/AT bus-based systems. Both devices work in conjunction with a PROM-based BIOS, so they provide complete IBM PC compatibility.

The FE2010 PC Bus CPU/peripheral controller IC replaces 71 components, including Intel's 8284 clock generator, 8288 bus controller, 8259A interrupt controller, 8237A DMA controller, and 8253 timer. It handles four DMA, eight interrupt, and three timer channels, and it supplies complete CPU controller logic and a keyboard port. The FE3000 integrates 53 components, including nonmaskable interrupt (NMI) and DMA control logic, an 8284/82284-compatible clock generator, and an 82288-compatible bus controller. It supports 6-, 8-, and 10-MHz clock speeds and can accommodate 256k- and 1M-bit dynamic RAMs. Both controllers come in 84-pin J-leaded surface-mount plastic chip carriers. Prices for the FE2010 and FE3000 are $76 and $45 (100), respectively. Delivery, 12 weeks ARO.

Faraday Electronics, 743 Pastoria Ave, Sunnyvale, CA 94086. Phone (408) 749-1900.

Circle No 679

Continued on pg 123

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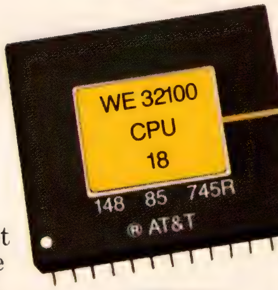

WE® 32100, heart of the first full 32-bit chip set.

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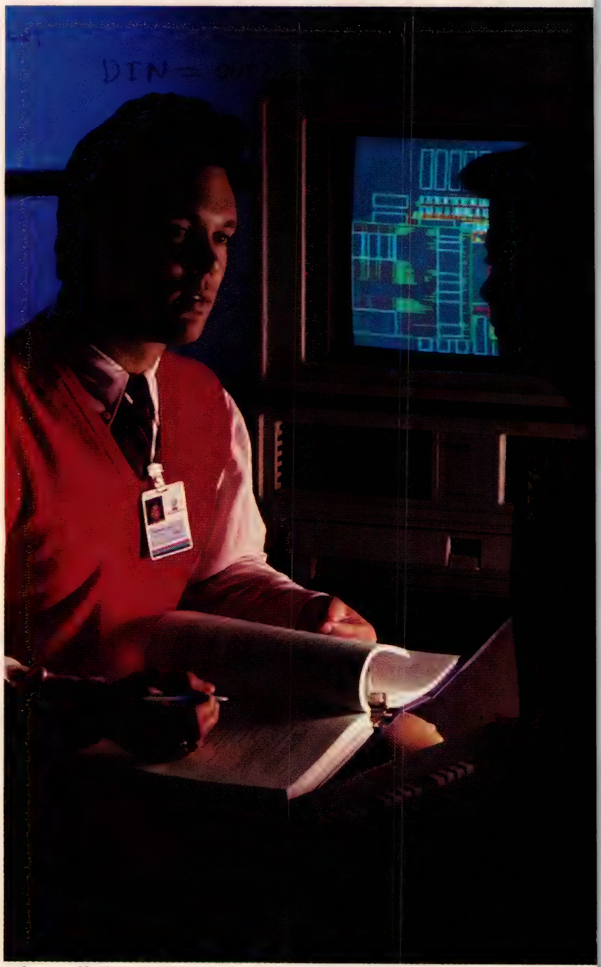

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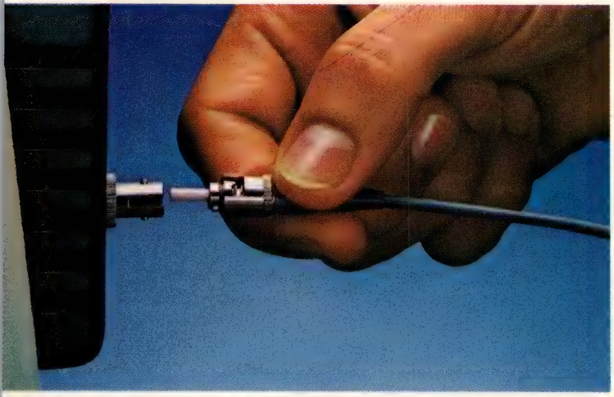

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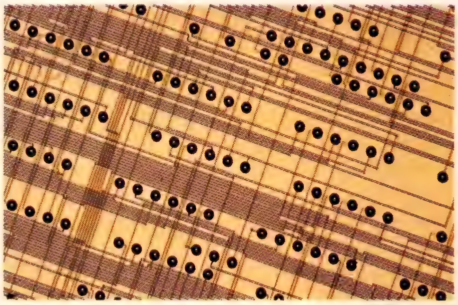

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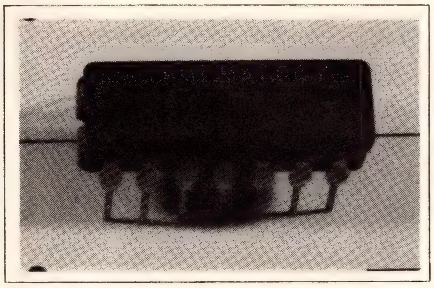


TRANSISTOR ARRAY

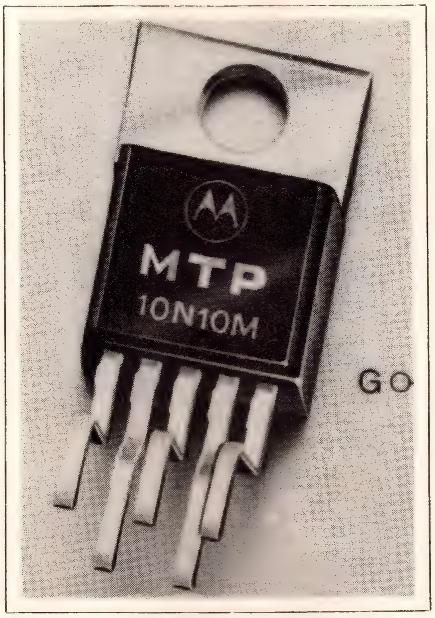
A quad monolithic npn-transistor array, the MAT-04, offers close matching of transistor parameters. At 25°C, the highest grade models (MAT-04A and -04E) spec 400 min, 800 typ h_{FE}. Gain matching is within 2% max. Offset voltage for the units is 150 μV max, and maximum input offset currents (at $I_C=100\ \mu A$) are 5 nA.

Over −25 to +85°C, the MAT-04E specs an h_{FE} of 225 min, 625 typ. Maximum offset voltage is 210 μV. Over −55 to +125°C, the MAT-04A specs h_{FE} of 175 min, 475 typ. Its maximum offset voltage is 250 μV. At 25°C, both units spec 40V min BV_{CEO}, 60-mV max $V_{CE(SAT)}$ (at $I_C=1$ mA), 5-pA typ I_{CBO}, and 300-MHz typ gain-bandwidth product. Input and output capacitance for all units is 40 and 10 pF typ, respectively. Packaged in 14-pin epoxy and hermetic DIPs, industrial- and military-range MAT-04 devices cost $5.40 and $10.40 (100), respectively.

Precision Monolithics Inc, Box 58020, Santa Clara, CA 95052. Phone (408) 727-9222. TWX 910-338-0218.

Circle No 678

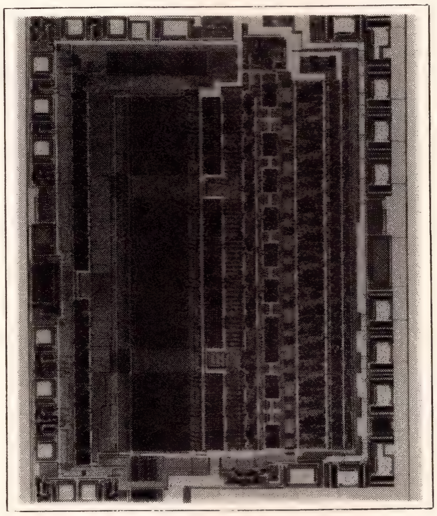
CURRENT-MIRROR FET



By providing access to a few source cells (of its many thousands), the MTP10N10M SENSEFET power MOSFET allows you to sense the current flowing in the device's load without the necessity of placing a resistor in the load path. You can measure the current flowing in the sense cells by placing a resistor from the sense-cell terminal to the negative load return. This current represents the current conducted by the power MOSFET, divided by the ratio (about three orders of magnitude) of active cells to the number of sense cells. The 100V, 10A MOSFET specs 0.25Ω on-resistance. Continous sense current peaks at 6 mA; pulsed sense current is as high as 14 mA. The device is housed in a 5-lead TO-220 package. $1.65 (100).

Motorola Semiconductor Products Inc, Box 20912, Phoenix, AZ 85036. Phone (602) 244-4911.

Circle No 681



ERASABLE CMOS PLD

You can substitute a PAL C 22V10, a CMOS PLD, for a bipolar 22V10 PLD and take advantage of the CMOS part's reprogrammability and lower power consumption. The PAL C 22V10 matches the timing parameters of the Am22V10A (25-nsec worst-case propagation delay), but consumes 80 mA vs the bipolar part's 180 mA. It can replace 10 other 24-pin PLDs as well: the 20L10, 20L8, 20R8, 20R6, 20R4, 12L10, 14L8, 16L6, 18L4, and 20L2.

You reprogram the part under an ultraviolet lamp, and thus you can change your design or use the part in another system. Two speed options are available for each grade of device: 25 and 35 nsec for commercial parts, and 30 and 40 nsec for devices specified over the military temperature range. Depending on speed option, commercial chips in plastic DIPs cost $28.35 or $17.25; military versions in cerdips cost $72 or $45 (100).

Cypress Semiconductor Corp, 3901 N First St, San Jose, CA 95134. Phone (408) 943-2666.

Circle No 682

D/A CONVERTER

The Bt450 monolithic triple 4-bit D/A converter operates at speeds as high as 70 MHz. The device integrates three 4-bit video DACs, a 16×12-bit dual-port color-look-up table, a 3×12-bit dual-port overlay palette, and a microprocessor interface. It supports as many as 19 simultaneous colors from a palette of 4096.

In computer-graphics applications, the chip generates RS-343A-compatible red, green, and blue video signals, including sync and blank, and drives doubly terminated 75Ω coax directly, without requiring external buffering. Differential- and integral-linearity errors are less than ±1/16 LSB and ±1/8 LSB, respectively. The device dissipates 550 mW and operates over 0 to 70°C. In a 28-pin hermetic ceramic DIP, $26 (100).

Brooktree Corp, 9950 Barnes Canyon Rd, San Diego, CA 92121. Phone (619) 452-7580.

Circle No 688

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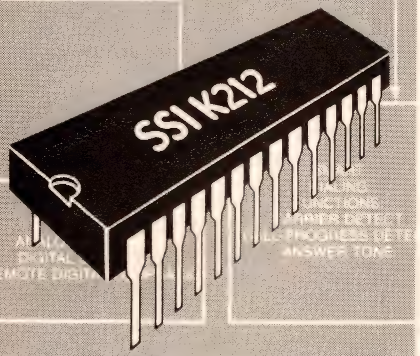

FEATURES:
- One-chip Bell 103/212A compatible modem IC
- Call progress detection and DTMF tone generator on-chip
- Easy to use 8-bit parallel bus (28 Pin DIP, QUAD) or optional serial bus for modem control (22 Pin DIP)
- Interfaces directly with 8051 or 8048 family of microprocessors
- Integrated analog and digital design provides exceptional performance
- Low power CMOS uses a single +10V supply

The SSI K212 is a complete Bell 212A modem on a single chip, and it incorporates all the primary functions needed for a typical intelligent modem. Included on a single chip are full Bell103 and 212A operating modes, a call progress monitor, and a DTMF dialer. The device also has an 8-bit parallel bus for control of modem functions and will directly interface with the 8048/8051 family of low-cost micro controllers. A complete modem requires only the addition of the phone line interface and a control microprocessor.

The one-chip K212 provides functions on a single chip which were previously only possible using many separate components. The new one-chip modem IC simplifies the design problem for users who are building modems for personal computer applications, and it is ideal for use in any self contained or integral modem system. The K212 provides exceptional performance under poor line conditions, and allows all Bell 212A operating modes.

For more information, contact: **Silicon Systems,** 14351 Myford Road, Tustin, CA 92680, **(714) 731-7110,** Ext. 595.

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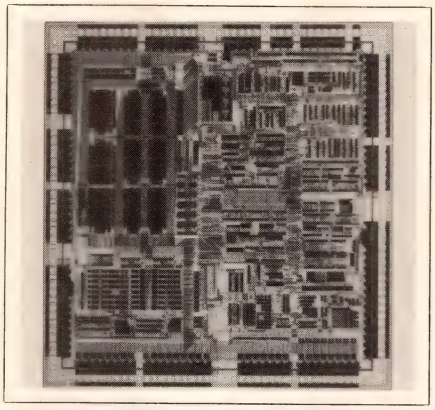
CIRCLE NO 160

ICs and Semiconductors



COPROCESSOR

The VL82C389 message-passing coprocessor (MPC) implements message-passing and -control functions on Multibus II-based systems. The chip controls solicited messages, such as DMA transfers, and unsolicited messages such as interrupts. It provides 32 multiplexed data/address lines, six parity lines, seven bus-arbitration lines, 12 lines to control information transfer, and six handshake lines for Multibus II's parallel system bus (iPSB). It also controls the system's local buses and interconnect buses, thereby reducing the load on the system's CPU. The chip can interact with 68000 family µPs in addition to the 80186, 80286, and 80386 µPs and is housed in a ceramic, 149-pin pin grid array. Samples are available for $200; volume production is scheduled to begin in the 4th qtr.

VLSI Technology Inc, Application Specific Logic Products, 10220 S 51st St, Phoenix, AZ 85044. Phone (602) 893-8574.

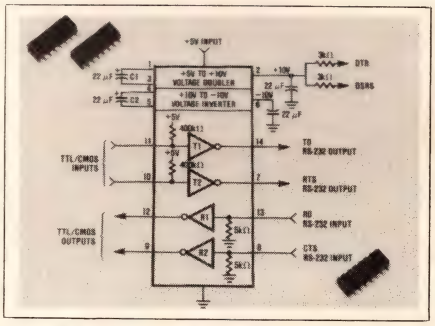
Circle No 684

12-nSEC PLDs

Although they are functionally equivalent to common 20-pin PLDs, the Impact circuits furnish a 20% shorter propagation delay than typical fast TTL devices—12 nsec vs 15 nsec. The TIBPAL16L8-12, TIBPAL16R4-12, TIBPAL16R6, and TIBPAL16R8-12 replace the PAL16L8B, PAL16R4B, PAL16R6B, and PAL16R8B devices, respectively. The TIBPAL16L8-12 offers two 3-state outputs, and the other three each include four, six, and eight output registers. Outputs can sink at least 30 mA. Characterized for operation between 0 and 75°C, the parts consume 200 mA max. They operate from 5V±5% supplies and come in 20-pin DIPs or chip carriers. $6.50 (1000). Delivery, 8 to 12 weeks ARO.

Texas Instruments Inc, Box 225012, Dallas, TX 75265. Phone (214) 995-2011.

Circle No 683



TRANSCEIVER

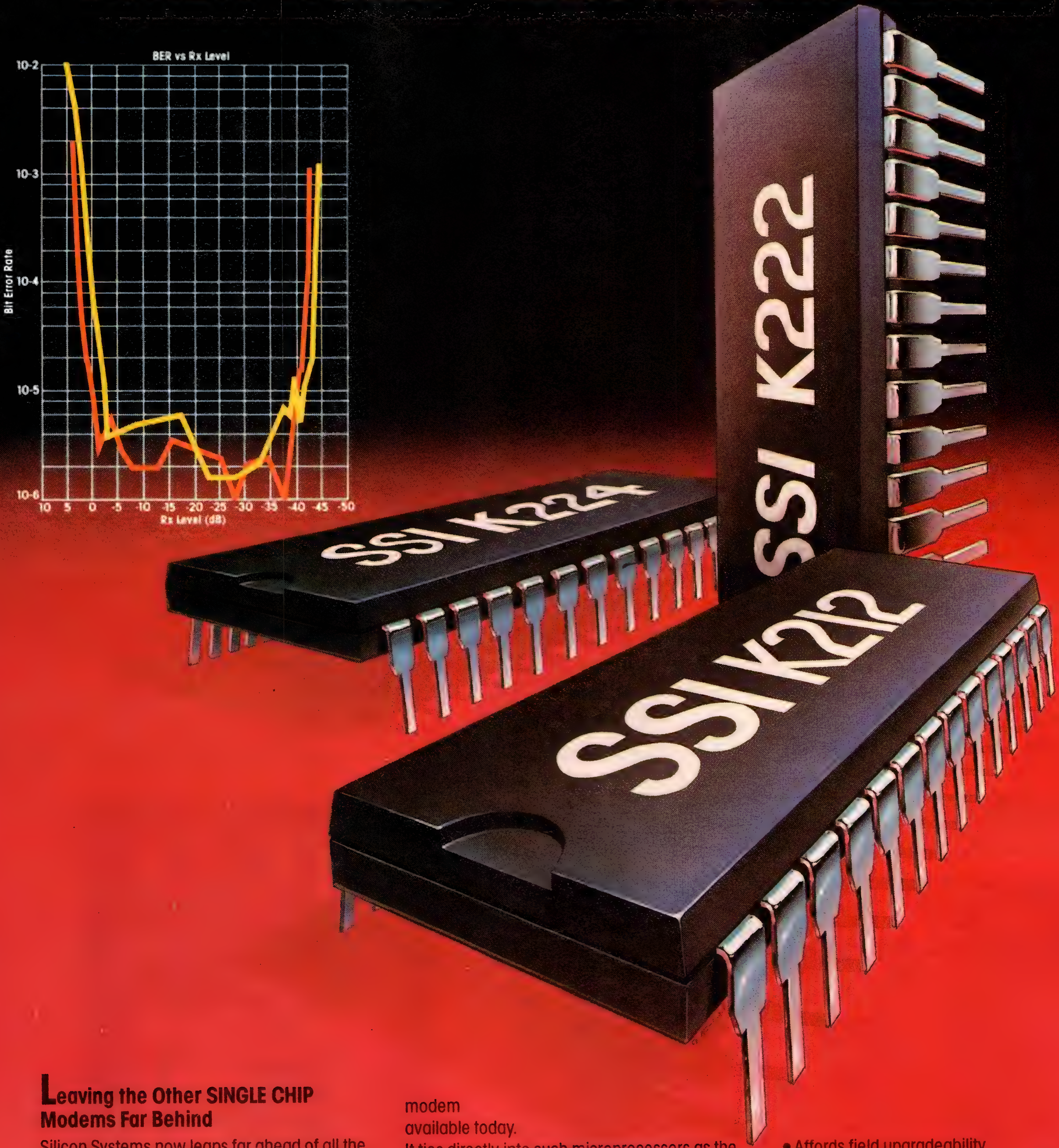
The MAX232 meets EIA RS-232C specifications, operates from one 5V supply, and replaces the ±12V supplies and two interface ICs commonly used in RS-232C communications links. The transceiver comprises dual RS-232C transmitters, dual RS-232C receivers, and a voltage-converter block that transforms 5 to 10V and +10 to −10V. The ±10V charge-pump voltage converters use four external electrolytic capacitors; the converters' chopping frequency is internally set to 16 kHz. The transmitter inputs are TTL and CMOS compatible, and the logic threshold is set at 1.5V when V_{CC}=5V.

The outputs' slew rate is limited to a value less than 30V/µsec. Power-down output impedance is 300Ω min when V_{CC} equals 0V and ±2V is applied to the outputs. Input impedance is between 3 and 7 kΩ. $3.60 to $7.20 (100).

Maxim Integrated Products, 510 N Pastoria Ave, Sunnyvale, CA 94086. Phone (408) 737-7600.

Circle No 685

A NEW WORLD-CLASS MODEM FAMILY



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The SSI K212 is the finest Bell 212A one-chip modem available today.

It ties directly into such microprocessors as the 80C51 through a standard bus, without requiring a special controller chip. And if you are anticipating the need for a V.22/V.21 1200 bps modem IC or a V.22 bis 2400 bps, the SSI K222 or the SSI K224 will meet your needs. Design in an SSI K212 now and plug in an SSI K222 or a K224 later. Plug it into the same holes in the same hardware using the same software, and you can take advantage of the industry's only no-penalty upward-design feature in modem IC's.

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Circle 80 for Product Information

Circle 119 for Career Information

DISK-DRIVE IC

The CS-279 disk-drive IC, a stepper-motor driver and logic interface for floppy-disk drives, provides all the logic functions needed for a standard disk drive. The IC also contains two high-current bridge outputs that you can connect directly to a bipolar stepper motor. In addition, it has high-current, open-collector outputs that you can connect directly to a host computer or interface.

Three comparators on the IC can work in tandem with photosensors or switches to detect three signal types: index pulses, track-00 signals, and write protection. An on-chip pull-down resistor provides a current path for the sensors. The logic accommodates full or half stepping, and the stepper driver provides output currents as high as 275 mA. An externally programmed one-shot determines the time delay for the ghost pulse; you can defeat the function by grounding the one-shot pin. The IC is housed in a 28-pin plastic DIP. $4.50 (1000).

Cherry Semiconductor Corp, 2000 South County Trail, East Greenwich, RI 02818. Phone (401) 885-3600.

Circle No 686

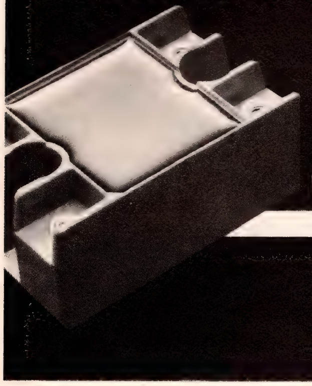
32-BIT CHIP SET

The WTL 7000 Series comprises two 32-bit chips, the WTL 7136 and 7137, that increase computation-intensive applications. The WTL 7136 sequencer integrates a 33-register stack, vectored-interrupt circuits, a code and data breakpoint register, and timing and status registers. The chip also includes stall and abort circuitry that allows it to work with variable-latency memory systems such as caches and static-column-mode dynamic RAMs.

The WTL 7137 integer processor and controller contains a 32-bit ALU, circuitry for shifting and merging fields of data, a 4-port register file with 32 registers, and a multiply/divide unit. You can configure the I/O of the bus in three ways: two bidirectional buses, one bidirectional bus, or an input bus and an output bus.

Both chips are capable of executing instructions in as little as 80 nsec. Some instructions initiate parallel operations, such as simultaneous interrupt detection and multiplication. Each device comes in a 144-pin pin-grid-array package and dissipates less than 1W. A 2-chip set specified for 100-nsec operation

Continued on pg 139



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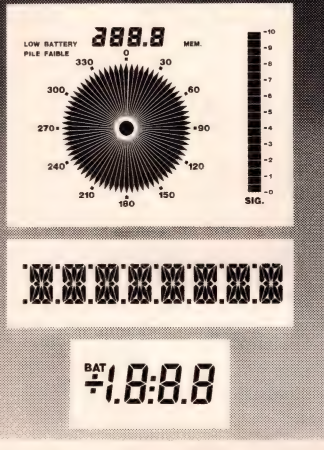

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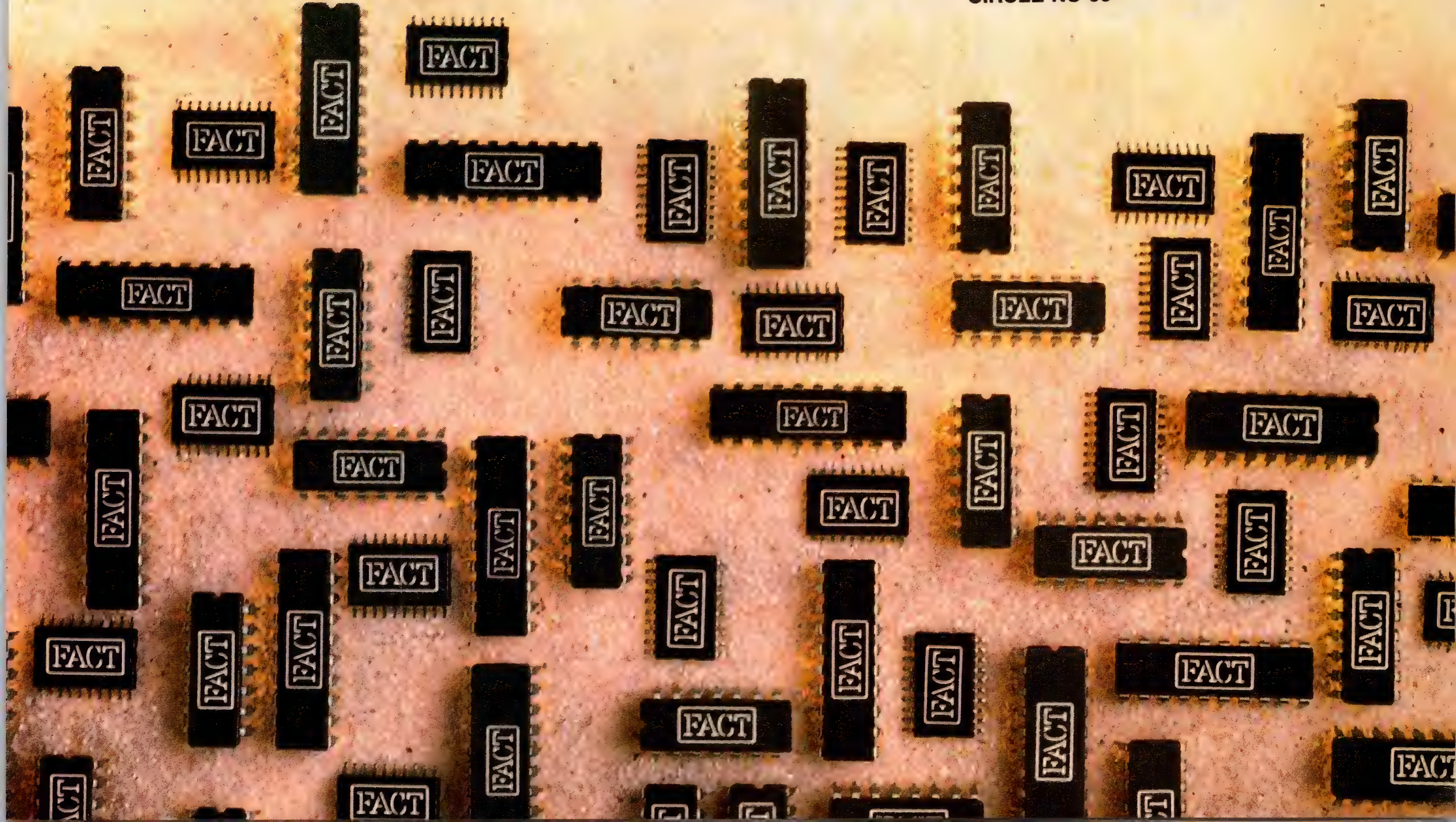

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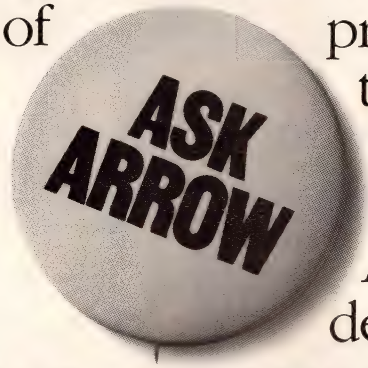

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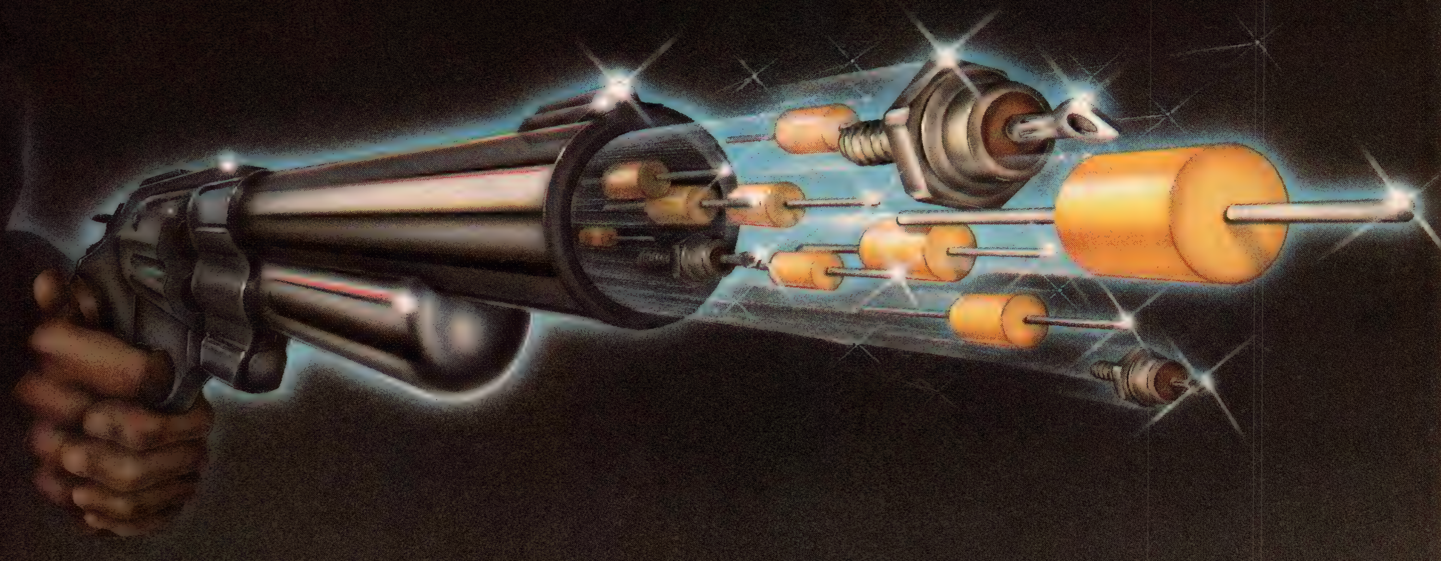

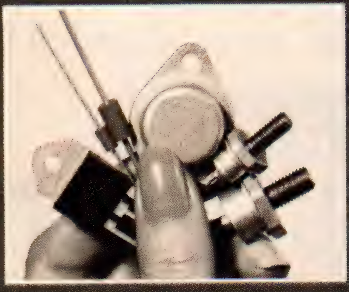

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CIRCLE NO 111

costs $385. Samples are available now; production quantities will be available in September.

Weitek Corp, 1060 E Arques Ave, Sunnyvale, CA 94086. Phone (408) 738-8400.

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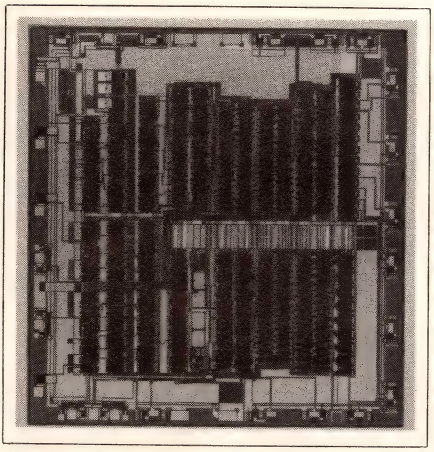
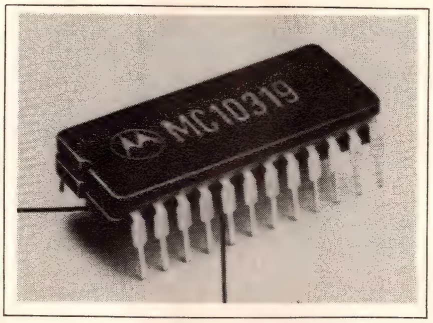


VIDEO IC

The Am8158 is a programmable video-timing controller for high-resolution bit-mapped graphics systems of 1k×1k pixels or more. The IC supports a 125M-dots/sec clock rate and has nine programmable registers that contain the timing parameters for generating control signals. It generates the necessary synchronization signals for the CRT display and other devices—for example, an Am8150 display refresh controller and an Am8177 video shift register—in a graphics system. You can program the number of pixels per memory access, memory accesses per scan line, and scan lines per frame, as well as the pulse widths of the synchronization signals. In a 28-pin ceramic DIP, $38.60 (100).

Advanced Micro Devices Inc, Box 3453, Sunnyvale, CA 94088. Phone (408) 982-7448.

Circle No 687



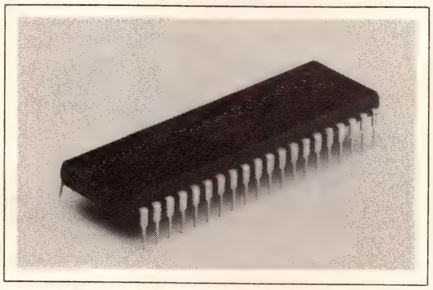
FLASH A/D CONVERTER

The MC10319 flash A/D converter performs a conversion every 40 nsec, resulting in a 25-MHz sampling rate. It supplies TTL-compatible 3-state outputs that you can connect directly to a μP bus. Input signals can range from 1 to 2V p-p—the appropriate range for video signals. Input impedance and capacitance are 16 kΩ and 55 pF, respectively. An overrange bit is available either for overrange detection or for connecting A/D converters to produce a 9-bit conversion circuit.

The device uses 256 comparators that feed a Grey-code translation circuit. It requires a 5V±10% supply and a negative power source between −6 and −3V. Typical power dissipation is 618 mW. The chip comes in a 24-pin ceramic DIP and is specified for temperatures between 0 and 70°C. $19.97 (1000).

Motorola Inc, Bipolar Analog Integrated Circuits Div, 7402 S Price Rd, Tempe, AZ 85283. Phone (602) 897-3872.

Circle No 690



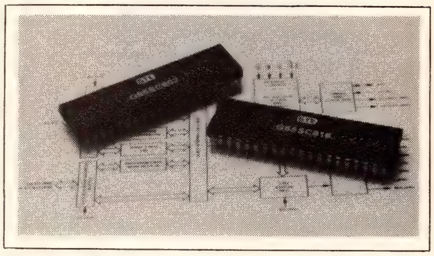
COAXIAL TRANSCEIVER

Over coaxial cable, the COM9064 transmits and receives signals that conform to the IBM 3270 interface display-systems standard (type A). It allows peripherals such as terminals, displays, printers, and LANs to communicate with IBM 3274 and 3276 control units. The chip provides the capabilities of the manufacturer's COM9004 transceiver, but doesn't require ±12V supplies as the COM9004 does.

The IC supports 2.35-MHz data transmission and reception over RG-62 coaxial cable. For cable lengths over 5000 ft, the IC automatically implements handshakes, parity generation, and error detection. Built-in diagnostics allow a control unit to check the functionality of the coaxial connection and the COM9064. The chip is available in plastic and ceramic DIPs as well as cerdips. A plastic DIP costs $16.95 (100).

Standard Microsystems Corp, 35 Marcus Blvd, Hauppauge, NY 11788. Phone (516) 273-3100.

Circle No 692



CMOS μPs

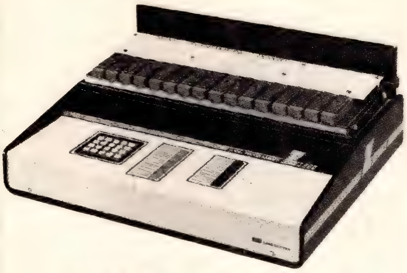
The G65SC802 and G65SC816 provide 16-bit processing to systems compatible with the G65SC00 family of CMOS μPs. The two devices maintain the 8-bit data bus of the G65SC00 family, but they provide a 16-bit internal architecture. The G65SC802 is pin compatible with the G65SC02 μP, allowing you to upgrade G65SC02-based systems without hardware modification. The G65SC816 provides 24 address lines so it can access 16M bytes of memory. It also supports dual-cache and DMA-cycle-steal operations.

Both ICs offer 24 addressing modes and 91 instructions with 255 op codes. A 16-bit register augments the G65SC00 family's direct-page addressing mode. They come in plastic or ceramic 40-pin packages. $20 (100).

GTE Microcircuits, 2000 W 14th St, Tempe, AZ 85281. Phone (602) 921-6505.

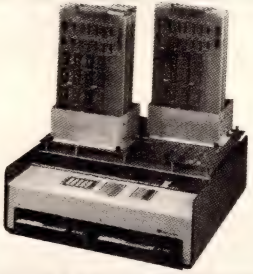
Circle No 698

AMERICA'S BEST PROGRAMMERS



Z-3000 HIGH VOLUME GANG/SET PROGRAMMER

- 14,000 27256s programmed per day.
- 32 EPROMs simultaneously with 1 to 8 DATA BLOCKS.
- 16 Intel or Motorola MCUs at a time.
- 64K to 256K bytes of DATA RAM.
- Simple one key programming operation.
- Two RS-232 ports with data transfer formats included.



Z-2500B IN-CIRCUIT MEMORY CARD PROGRAMMER

- Programs up to 32 memory cards with EPROMs or microcomputers at a time.
- Two 1.2 Mbyte DSDD floppy disk drives. Optional 20 Mbyte hard disk.
- Turnkey systems include programmer, terminal, custom interface hardware and software.
- Simple menu driven operation.

Z-1000B UNIVERSAL PROGRAMMER

- Over 600 PLDs, EPROMs, EEPROMs, bipolar PROMs and INTEL MCUs.
- Upgradeable PROM based software.
- Stand alone or PC/XT/AT operation.
- Two independent RS-232 ports.
- 64K or 256K bytes of DATA RAM.
- EXATRON handler interface is standard.

Z-1200B TWELVE SOCKET GANG/SET PROGRAMMER

- 2716-27512, 1 to 4 DATA BLOCKS.
- 64K to 256K bytes of DATA RAM.
- Software personality. No plug-ins.

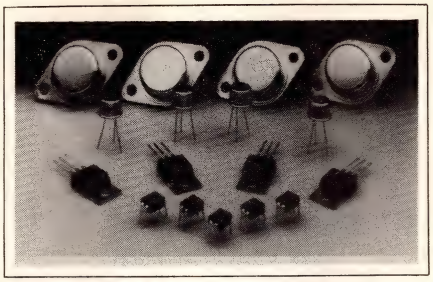
ZAP SERIES low cost programmers for EPROMs and single-chip MCUs.

Z-400 for bipolar PROMs and EPROMs.

SUNRISE ELECTRONICS, INC.
524 South Vermont Avenue
Glendora, California 91740
(818) 914-1926

CIRCLE NO 199

ICs and Semiconductors



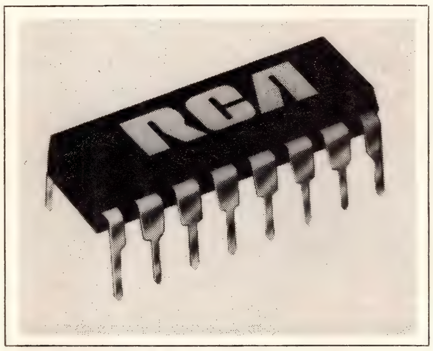
POWER MOS DEVICES

The MOSPOWER family of p-channel power MOSFETs suit use in industrial and high-reliability applications that normally would require bipolar power transistors. The 26 devices feature source-to-drain breakdown voltages ranging from −60 to −200V; when turned on, the devices exhibit a resistance from 0.3 to 2.4Ω. The company's Duramos process produces transistors with guaranteed gate-to-source breakdown voltages as high as 40V.

Packaging options include hermetic TO-3, hermetic TO-39, and plastic TO-220 packages, and an autoinsertable 4-pin DIP. $1.98 to $10.39 (100). Delivery, stock to eight weeks ARO.

Siliconix Inc, 2201 Laurelwood Rd, Santa Clara, CA 95054. Phone (408) 988-8000.

Circle No 693



POWER OP AMP

Suitable for data-conversion and video circuitry, the CA3450 power op amp provides a 170-MHz bandwidth typ at unity gain when driving a 50Ω load. Slew rate at unity gain is 160V/μsec. When operating as an inverting amplifier, the device has a settling time to 0.1% of 35 nsec. It can drive a 7V p-p signal into a 50Ω load at frequencies as high as 10 MHz.

For video line-driving applications, the CA3450 can source or sink 75 mA (at voltages as high as 8V p-p) into or out of a 75Ω load. You can run the device from either one 16V source or from dual 8 and −8V supplies. Using external terminals, you can compensate for offset voltage and phase error. Housed in a 16-pin plastic DIP, the chip is rated for operation over −25 to +100°C. $3.75 (100).

RCA, Solid State Div, Box 3200, Somerville, NJ 08876. Phone (201) 685-6426.

INQUIRE DIRECT

ECL RAM

The DM10422A-7 ECL RAM provides a worst-case access time of 7 nsec for any of its 1024 bits. The 24-pin device contains 256 addresses, each with 4 bits. You can reconfigure the device, using block-control signals, to operate as a 512×2- or a 1024×1-bit RAM. Intended for scratch-pad memories and control-store applications, the device is compatible with 10K and 10KH ECL signal levels. In addition to a 7-nsec access-time model, the part is available in versions that have 10- and 12-nsec access times. Also, a version compatible with 100K ECL logic is scheduled for availability in this qtr. In a ceramic DIP, $13 (100).

National Semiconductor Corp, Box 58090, Santa Clara, CA 95052. Phone (408) 721-5540.

Circle No 691

CMOS LOGIC

The Fact family of logic devices meets JEDEC standards for bipolar 74HCXX Series devices; however, when the CMOS Fact ICs are in their quiescent state, they draw as little as 1/1000 of the power of the 74HCXX devices. Typical gate propagation delays don't exceed 5 nsec measured over a supply-volt-

Continued on pg 146

YOU CAN TELL A LOT ABOUT
A SEMICONDUCTOR COMPANY BY WHERE
THE MANAGEMENT HANGS OUT.

When you deal with the new Thomson Components-Mostek, there's no telling where you'll run into a member of our management team. Which tells you a lot about the way we run our business.

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We've also combined our 2μ HCMOS technologies with our advanced Highland 2^{sm} CAD system to create one of the most sophisticated gate array and standard cell semicustom capabilities around. And while we're on the subject of services, our 10,000-square-foot VLF photomask facility provides high-quality photomask and reticle writing services on a project basis.

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So call, write or come by and visit. We'll show you our facilities, our people and our products. And while there's no telling where you'll find our management team, you can be sure they'll do their best to help with your component needs.

CIRCLE NO 182

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MK48T02 – Timekeeper SRAM
MK48Z02 – ZEROPOWER SRAM
MK48C02 – Battery/Back-up SRAM
MK41Hxx – 16K Very Fast CMOS SRAMs
MK4501 – BiPORT FIFO
MK4511 – BiPORT RAM
MK4801A – Fast SRAM
MK6116 – CMOS SRAM
ET2147 – Fast SRAM
ETL2128 – CMOS SRAM
ET2716 – 2K x 8 – NMOS EPROM
ETC2732 – 4K x 8 – CMOS EPROM
TS27C64 – 8K x 8 – CMOS EPROM
TS27C256 – 32K x 8 – CMOS EPROM
TS27C64 – 8K x 8 – One-time Programmable EPROMs
TS27C256 – 32K x 8 – One-time Programmable EPROMs
TS71180A & 81 – 1K x 8 – Bipolar PROMs
TS71190A & 91 – 2K x 8 – Advanced TTL Bipolar PROMs
TS71290C & 91 – 2K x 8 – Bipolar PROMs
TS71321 – 4K x 8 – Bipolar PROMs
TS71121 – 4K x 8 – Bipolar PROMs
TS71641 – 8K x 8 – Bipolar PROMs

APPLICATION SPECIFIC ICs

Double level metal HCMOS gate arrays
GA Series – 3 micron to 4,000 gates
GB Series – 2 micron to 10,000 gates
GC Series – 1.2 micron version of GB family
Double level metal HCMOS standard cell family
SA Series – 3 micron RAM, ROM, PLA, I/O
SB Series – 2 micron

MICROCOMPONENTS

2900 family Bipolar microprocessors
EF6800 family 8-bit microprocessors
MK3880 – Z80™ family
6800 family 8-bit peripherals
68000 family 16-bit microprocessors
68000 family 16-bit peripherals
ET9400 family 4-bit microcomputers
EF6804 family 8-bit microcomputers
EF6805 family 8-bit microcomputers
MK3870 family single-chip 8-bit microcomputers
EF6801 family
MK68200 family single-chip 16-bit microcomputer

DATA COMMUNICATION CIRCUITS

MK68590 Ethernet Controller
MK68591/2 – Serial Interface Adapter
MK5025 – ISDN Packet Switching (CCITT x .25)
MK5027 – System Signaling #7
MK5030 – STARLAN HUB chip
MK5033 – G.P. Manchester encoder/decoder
MK5035 – STARLAN STATION chip

TELECOMMUNICATIONS CIRCUITS – SWITCHING

EFB7303
EFB7310
EF7332
EF7333
MK5316 family of CODECs and filters
ETC5054 CODEC and filter
ETC5040 PCM filters
MK5116 family of CODECs

TELEPHONE SET DEVICES

TEA3046 single-chip telephone
MK5380 DTMF dialer
MK5371 Series TonePulse™ dialers
MK5375 Series TonePulse dialers
TEA7031 Loudspeaker amplifier

HIGH-SPEED DATA CONVERSION DEVICES

HCMOS MASK PROGRAMMABLE FILTERS (MPF)

TELECOMMUNICATIONS CIRCUITS/MODEMS

EFG7515 – 212A modem
EF7910 – Asynchronous monochip FSK modem
TS68930/1 – Digital Signal Processor
TS68950/1/2 – V.32 modem analog front end

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818/887-1010

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CIRCLE NO 209

If your system is only using this many colors,
isn't it time to grow up?

The INMOS IMSG170 Color Look-up Table offers a grown-up solution to video display color enhancements. It lets you and your RGB analog display advance to a palette of more than a quarter million colors.

This programmable DAC conforms to RS170A standards with pixel rates up to 50 MHz, in a 28 pin package.

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The Color Look-up Table from INMOS. Designing with thousands of colors just became child's play.

INMOS Corporation, Colorado Springs, Colorado, Tel. (303) 630-4000
Bristol, England, Tel. 0272-290-861
Paris, France, Tel. (1) 687-2201
Munich, Germany, Tel. (089) 319-1028

inmos

Compare your computer design colors to these crayons. If the crayons win, call INMOS.

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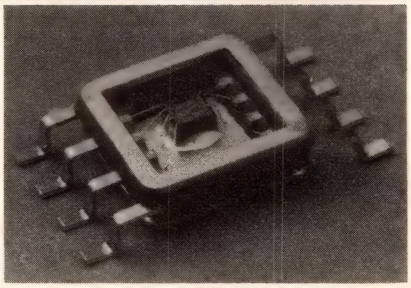
CIRCLE NO 188

age range of 4.5 to 5.5V and 3.3±0.3V. The manufacturer also guarantees operation of the parts over supply voltages from 2 to 6V.

Commercial-grade devices (74AC/ACT) are specified over −40 to +85°C. Outputs can sink or source 24 mA. These devices can drive 50Ω lines; military-temperature-range devices (54AC/ACT) can drive 75Ω lines. The chips resist latch-up at forced input currents as high as 100 mA. The series includes octal buffers, octal latches, multiplexers, gates, and flip-flops. $0.33 to $9 (100).

Fairchild Digital Products Unit, 333 Western Ave, South Portland, ME 04106. Phone (207) 775-8783.

Circle No 697



GaAs MICROWAVE ICs

This series of GaAs monolithic microwave ICs (MMICs), which convert RF signals to IF signals, has three additional members: the PM-CB0301-A, the PM-CO0601-A, and the PM-CV08012-A. Each device includes an RF amplifier, a mixer, a local oscillator, and IF amplifiers. The PM-CV0301-A accepts RF signals with frequencies between 1 and 3 GHz and provides an output between 100 and 800 MHz. The PM-CO0601-A accepts signals ranging from 3 to 6 GHz and drives 50- to 2000-MHz signals. The PM-CV0801-A is appropriate for input signals between 5 and 8 GHz, and it supplies an IF frequency of 50 to 500 MHz.

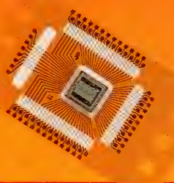
All three devices require 5V supplies. They come in 8-lead, 0.062-in.-thick surface-mount packages. Devices with optional external or internal local oscillators come in 0.670-in.-thick packages. $50 (10,000).

Pacific Monolithics Inc, 245 Santa Ana Ct, Sunnyvale, CA 94086. Phone (408) 732-8000.

Circle No 694

BARREL SHIFTER

The LSH32 parallel barrel shifter and normalizer performs shift or rotate commands on 32-bit words. Maximum propagation delay from input to output is as low as 42 nsec. In applications where a 32-bit single-pass barrel shift is necessary, the device can replace as many as 32 SSI parts. It implements arithmetic, logical, and circular shift instructions for reformatting operations.



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Leadership in CMOS/DMOS Technologies

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AN01	160 to 400V	8 N-Channel Low Leakage Common Source Driver
AP01	160 to 400V	8 P-Channel Low Leakage Common Source Driver
HV01	60V	16 Channel, 16 Level Gray Shade Push-Pull Output Driver
HV02	250V	16 Channel, High Current Open-Drain Output Driver
HV03 & 05	200 & 300V	64 Channel Serial to Parallel Converter with Open-Drain Outputs
HV04 & 06	40, 60, & 80V	64 Channel Serial to Parallel Converter w/ Push-Pull Outputs
HV10-18	140 & 160V	4 or 8 Channel Bilateral Analog Switch
HV30	180V	7 Segment Decoder w/ Open-Drain Outputs
HV51 & 52	225 & 300V	32 Channel Serial to Parallel Cnvrtr. w/ High Volt. Open-Drain Outputs
HV53 & 54	40, 60, & 80V	32 Channel Serial to Parallel Cnvrtr. w/ High Volt. Push-Pull Outputs

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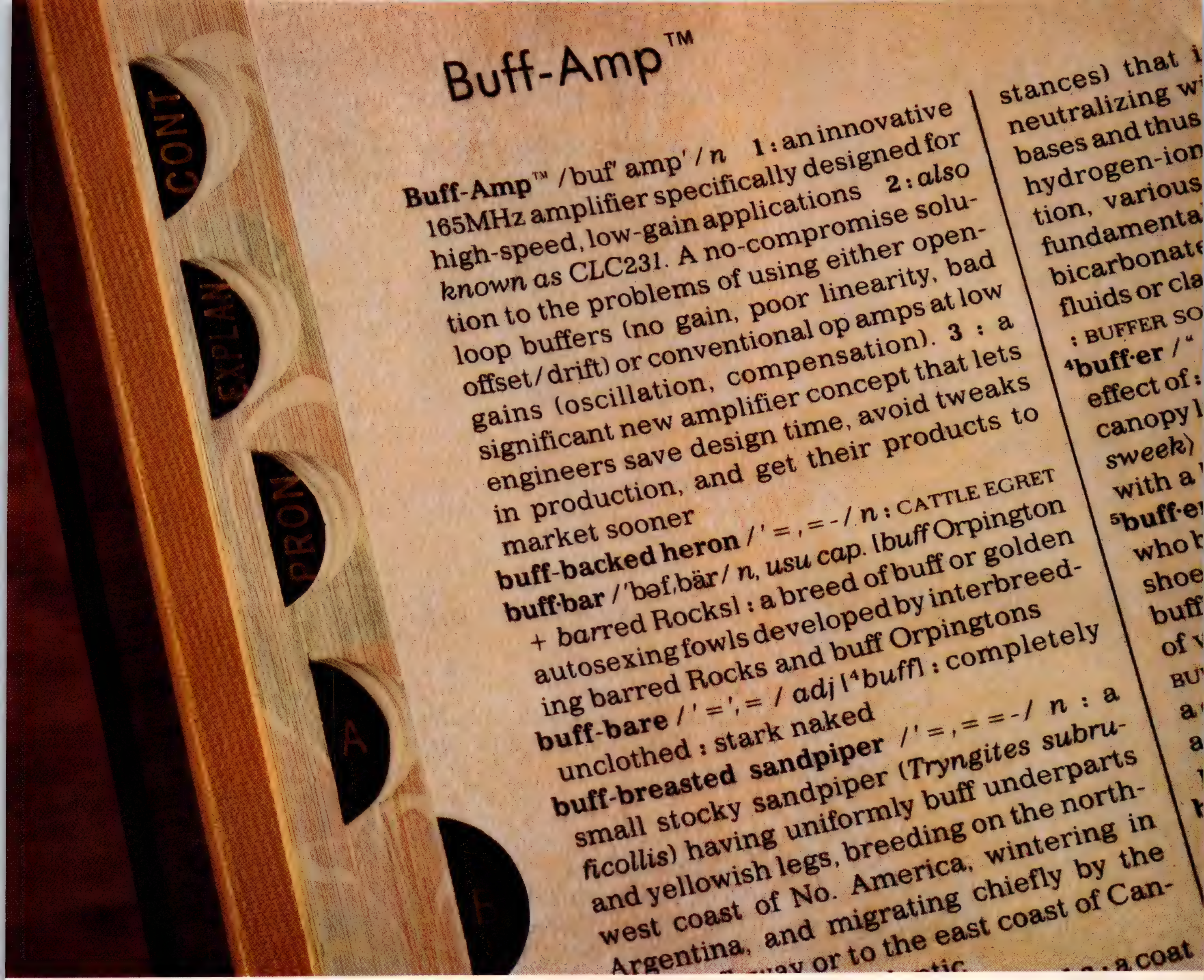
CIRCLE NO 5



Buff-Amp™

Buff-Amp™ /buf' amp' / *n* **1** : an innovative 165MHz amplifier specifically designed for high-speed, low-gain applications **2** : *also known as* CLC231. A no-compromise solution to the problems of using either open-loop buffers (no gain, poor linearity, bad offset/drift) or conventional op amps at low gains (oscillation, compensation). **3** : a significant new amplifier concept that lets engineers save design time, avoid tweaks in production, and get their products to market sooner

buff-backed heron /'=,=-/ *n* : CATTLE EGRET

buff·bar /'bəf,bär/ *n, usu cap.* [buff Orpington + barred Rocks] : a breed of buff or golden autosexing fowls developed by interbreeding barred Rocks and buff Orpingtons

buff-bare /'=',=/ *adj* [⁴buff] : completely unclothed : stark naked

buff-breasted sandpiper /'=,==-/ *n* : a small stocky sandpiper (*Tryngites subruficollis*) having uniformly buff underparts and yellowish legs, breeding on the northwest coast of No. America, wintering in Argentina, and migrating chiefly by the

How to enrich your high-speed, low-gain vocabulary in 30 seconds or less.

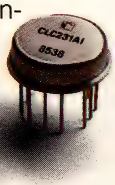
Once you've gleaned the meaning of Buff-Amp,™ you'll know how to get the best features of high-speed op amps and high-performance buffers. From a single device!

With Buff-Amp,™ you get gains from ±1 to ±5 without sacrificing the 165MHz -3dB bandwidth. Linearity that is a true 0.1%, even with demanding 50 ohm loads. A 1mV input offset and 10μV/°C drift. *Plus* freedom from oscillation across the entire gain range... without compensation.

There's nothing academic about the specs of Buff-Amp™ in real-world operation at the system level. You can be sure of a 95MHz full power bandwidth. A 15ns settling time to 0.05%. A 100mA output current. A 3000V/μs slew rate. A 2.0ns rise time. And, in many designs, the ability to operate on ±5V and 5mA—just 50mW of power. That's unabridged performance in anyone's book!

Buff-Amp™ is the astute choice for tasks such as driving flash A/Ds or matched lines, or buffering current-output DACs, in EW, ATE, and other applications.

Now that you've taken 30 seconds to enrich your high-speed, low-gain vocabulary, take a few more and call or write us for complete literature. Comlinear Corporation, P.O. Box 20600, Fort Collins, CO 80522, (303) 226-0500.



Comlinear
Corporation

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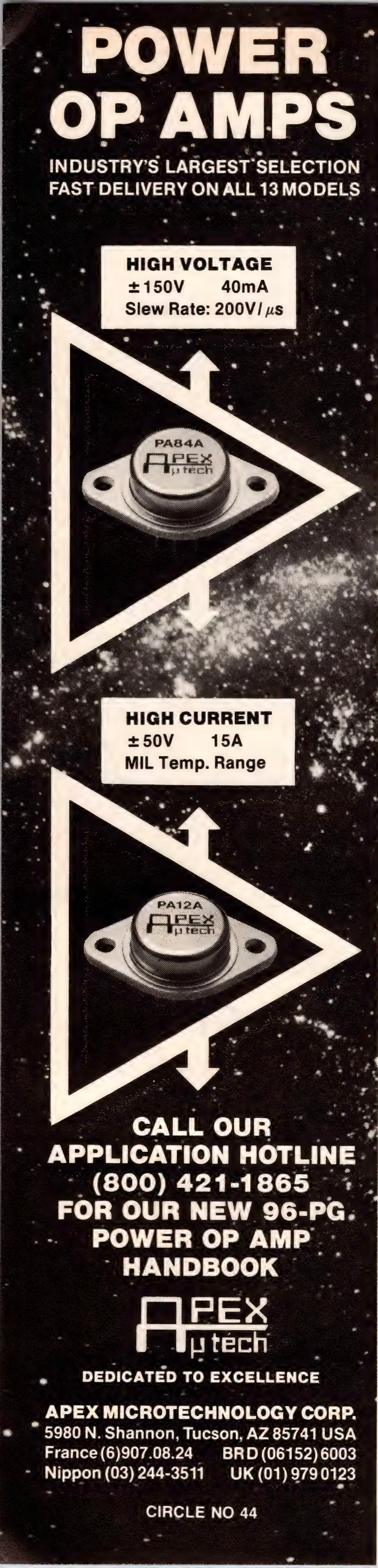
CIRCLE NO 97



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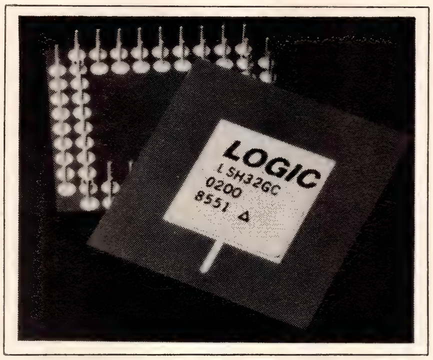
CIRCLE NO 44



The device features a 32-bit priority encoder that enables it to automatically determine the correct shift for floating-point normalization. Input is provided on 32 input lines; the chip multiplexes the 32-bit output over a 16-bit output port. Operating from a 5V±5% supply, the IC consumes 30 mA max. In a pin grid array, $45.50; in a plastic LCC, $32.50 (100).

Logic Devices Inc, 628 E Evelyn Ave, Sunnyvale, CA 94086. (408) 720-8630.

Circle No 696

INTERFACE IC

The IXSSE501 shaft-encoder interface IC delivers position and velocity feedback from motors to microprocessors. The device provides index-pulse reading and differential line-receiver input functions. Index-pulse reading implements error detection and homing in addition to velocity control for high motor speeds. The RS-422-compatible, Schmitt-triggered differential line-receiver input provides accurate pulse counting and noise immunity.

The device also features quadrature decoding to quadruple shaft-encoder line resolution. It has an 8-bit digital design that allows high motor speeds: 38,000 rpm max with a 100-line encoder and a 2-kHz sample rate, and 3000 rpm max with a 2500-line encoder and a 4-kHz sample rate. In a 20-pin DIP, $9.80 (100).

Ixys Corp, 142 Charcot Ave, San Jose, CA 95131. Phone (408) 435-1900.

Circle No 730

CMOS EPROM

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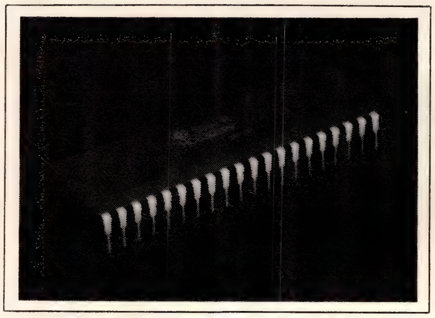
Waferscale Integration Inc, 47280 Kato Rd, Fremont, CA 94538. Phone (415) 656-5400.

Circle No 729



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CIRCLE NO 181

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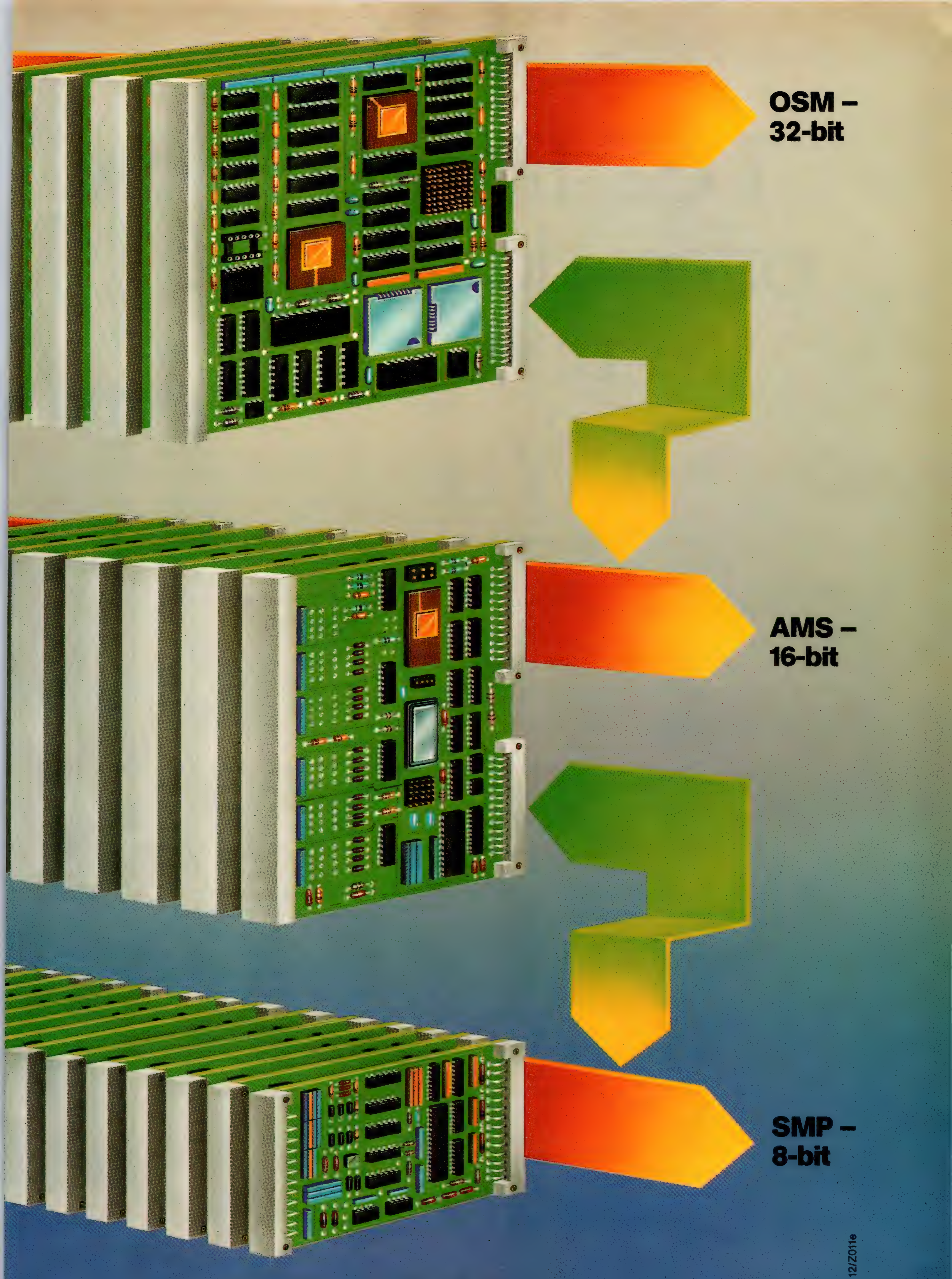


CIRCLE NO 128

DSP-filter software offers design help to novices

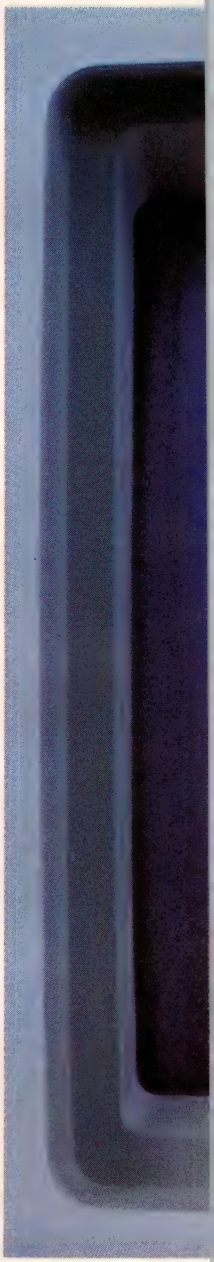
Robert H Cushman,
Special Features Editor

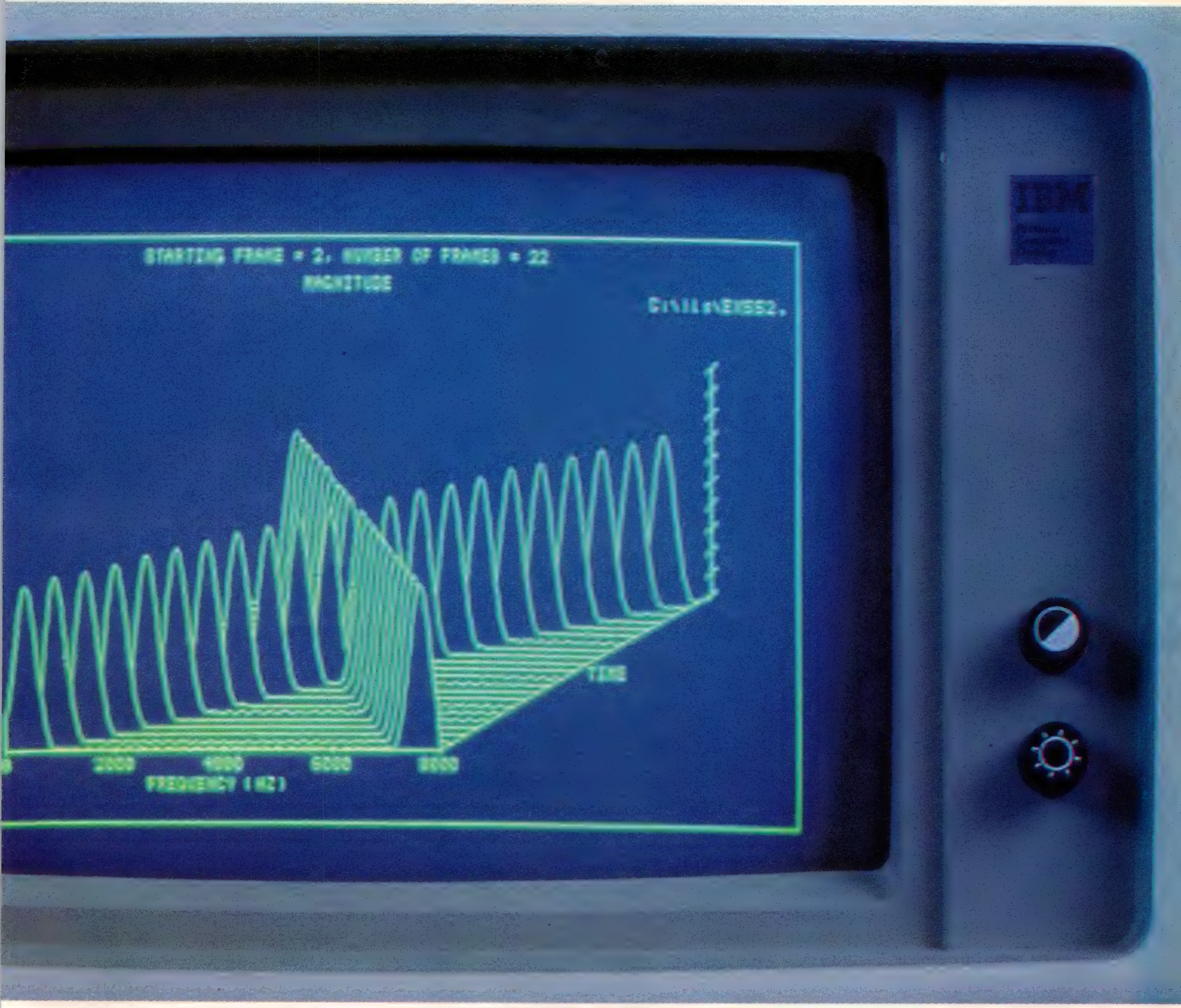
You may already have noted that the task of designing filters for digital-signal-processing (DSP) systems is becoming a larger part of your job as more DSP μPs appear—for example, Analog Devices' 16-bit fixed-point 2100 and NEC's 24-bit floating-point 77230. If you're lacking experience in DSP-filter design, and you find suddenly that you have to build such a filter, you may be able to postpone taking courses in DSP theory by relying on one of the relatively new DSP-design software packages.

A hands-on evaluation of some of today's digital-signal-processing software shows how those unfamiliar with the mathematical complexities of DSP filters can arrive at serviceable designs.

Trying to design a digital filter is ordinarily a complex, computationally tedious challenge, and if the assignment is to develop a system of filters—for a high-speed modem, a speech recognizer, or an adaptive noise canceler, for example—nothing less than expertise is required. But designing an individual lowpass, highpass, bandpass, or bandstop digital filter with one of the commercially available software packages is only an hour's work.

The cost of CAD software packages like these DSP filter-design programs may appear to be high, but you shouldn't judge the cost of these programs against those for popular software packages. Rather, you should compare the prices with the cost of lost engineering efficiency. A program that cuts the time to design a basic filter from days down to hours is clearly a tool that enhances productivity. Applying more than one of these packages to a design problem can be beneficial as well, for in some cases they complement one another. In certain situations, purchasing these programs can be a better investment than enrolling in a college course on DSP-filter design.





3-D display of a swept frequency's FFTs *(Signal Technology Inc)*

Designing a basic lowpass, highpass, bandpass, or bandstop digital filter with one of the commercially available software packages is only an hour's work.

Table 1 lists software packages intended for DSP-filter design and analysis. All but the IEEE programs run on IBM PCs. Whitman Engineering's Madcap (Modular, Access Design, Computer-Aided Processing) package also runs on the Apple II. The IEEE set—at least in the inexpensive book form—should be in every DSP designer's library. These programs are the source programs that have been the foundation for all the other packages. The main additions in the other, more expensive packages are extensive user-friendly interfaces.

Whitman's Winthrop Smith Jr, creator of Madcap, demonstrated the program for us on his PC. Madcap is a good supervisory program, with a large capacity for files and the ability to perform fast Fourier transforms (FFTs). Smith has provided software hooks that allow the user to expand Madcap with other programs, such as Atlanta Signal Processors Inc's DFDP (Digital Filter Design Package) and assemblers for the Texas Instruments 32010 and 32020 DSP chips. When we ran Signal Technology's ILS demonstration disk, we were impressed by its 3-D graphics. The ILS package is an

TABLE 1—REPRESENTATIVE DIGITAL-FILTER-DESIGN SOFTWARE PACKAGES

SUPPLIER	PACKAGE	PURCHASING DETAILS	DESCRIPTION AND COMMENTS	READER SERVICE NO
ATLANTA SIGNAL PROCESSORS INC 770 SPRING ST ATLANTA, GA 30308 (404) 892-7265	DFDP (DIGITAL FILTER DESIGN PACKAGE), VERSION 2.0	$1195. COMES ON TWO 5¼-IN. FLOPPY DISKS, WITH MANUAL.	INITIALLY COMMISSIONED BY TEXAS INSTRUMENTS TO SUPPORT THE 32010 DSP μP. DOES NOT HAVE FFTs OR TIME RESPONSES BEYOND THE BASIC IMPULSE. PROGRAMS ARE IN FORTRAN. RUNS ON IBM PCs.	CIRCLE NO 614
IEEE INC 345 E 47th ST NEW YORK CITY, NY 10017 (212) 705-7900	A SET OF PROGRAMS FOR DIGITAL SIGNAL PROCESSING (1979)	$36.60 IN BOOK FORM. $62.95 ON ½-IN. TAPE (600-FT REEL, 800 OR 1600 BPI, EBCDIC, FOR MINICOMPUTERS AND MAINFRAMES).	FURNISHED AS A NONPROFIT SERVICE BY MEMBERS OF THE IEEE ACOUSTICS, SPEECH AND SIGNAL PROCESSING GROUP. SET CONSISTS OF 29 PROGRAMS IN ANSI-STANDARD FORTRAN, COVERING DISCRETE FOURIER TRANSFORMS, POWER-SPECTRUM ANALYSIS AND CORRELATION, FAST CONVOLUTION, LINEAR PREDICTION ANALYSIS OF SPEECH SIGNALS, FIR AND IIR FILTER DESIGN AND SYNTHESIS, CEPSTRUM ANALYSIS, INTERPOLATION, AND DECIMATION.	CIRCLE NO 615
SIGNAL TECHNOLOGY INC 5951 ENCINA RD GOLETA, CA 93117 (805) 683-3771	ILS (INTERACTIVE LABORATORY SYSTEM)	$995 FOR PC-1 BASIC MODULE. $1495 FOR PC-2 ADD-ON MODULE. COMES ON 5¼-IN. FLOPPY DISKS.	THESE PROGRAMS PERFORM DSP-FILTER DESIGN AND MANY MORE OPERATIONS. FOR EXAMPLE, THEY CALCULATE MOVING AND EXPONENTIAL AVERAGES, ADD NOISE TO SIMULATE NOISY DATA, PERFORM LIMITING AND MODULATION, FIND EXTREMES IN DATA RECORDS, AND PERFORM AUTO- AND CROSS-CORRELATION. THE 3-D CEPSTRUM DISPLAYS ARE IMPRESSIVE. PROGRAMS ARE IN FORTRAN. PACKAGE RUNS ON IBM PCs WITH 256k BYTES OF MEMORY.	CIRCLE NO 616
SIGNIX CORP 19 PELHAM ISLAND RD WAYLAND, MA 01778 (617) 358-5955	DISPRO (DIGITAL SIGNAL PROCESSING SOFTWARE), VERSION 1.5	$1450. COMES ON ONE 5¼-IN. FLOPPY DISK, WITH MANUAL.	SIMILAR TO ATLANTA SIGNAL PROCESSORS' DFDP. NOT QUITE AS USER FRIENDLY, BUT HAS A WIDER RANGE OF ANALYSIS FUNCTIONS, INCLUDING FLEXIBLE TIME-DOMAIN RESPONSE TO USER-GENERATED INPUTS, AND FFT ANALYSIS. PROGRAMS ARE IN COMPILED BASIC. PACKAGE RUNS ON IBM PCs. AN 8087 VERSION IS ALSO AVAILABLE.	CIRCLE NO 617
WHITMAN ENGINEERING INC 520 S MAITLAND AVE MAITLAND, FL 32751 (305) 628-4516	MADCAP (MODULAR, ACCESS DESIGN, COMPUTER-AIDED PROCESSING)	$1595. COMES ON TWO 5¼-IN. FLOPPY DISKS, WITH MANUAL.	CAN SERVE AS A SUPERVISORY PROGRAM THAT RUNS ATLANTA SIGNAL PROCESSORS' DFDP AS A UTILITY, ENHANCING DFDP WITH FFT ANALYSIS AND GREATER FILE CAPACITY. INCLUDES PROPRIETARY DISCRETE FOURIER TRANSFORM THAT, ACCORDING TO THE SUPPLIER, IS SUPERIOR TO POWER-OF-TWO FFT ANALYSIS IN ITS ABILITY TO CENTER FFT FILTERS ON THE FREQUENCY UNDER INVESTIGATION. EXPANDABLE BY THE USER. PROGRAMS ARE IN COMPILED BASIC. PACKAGE RUNS ON IBM PCs AND APPLE IIs.	CIRCLE NO 618

extensive one; it provides more general scientific-computation features, beyond the DSP realm, and it could be a useful complement to DSP programs like those provided in the Atlanta DFDP and Signix Dispro (Digital Signal Processing Software) packages.

Evaluation requires intimacy

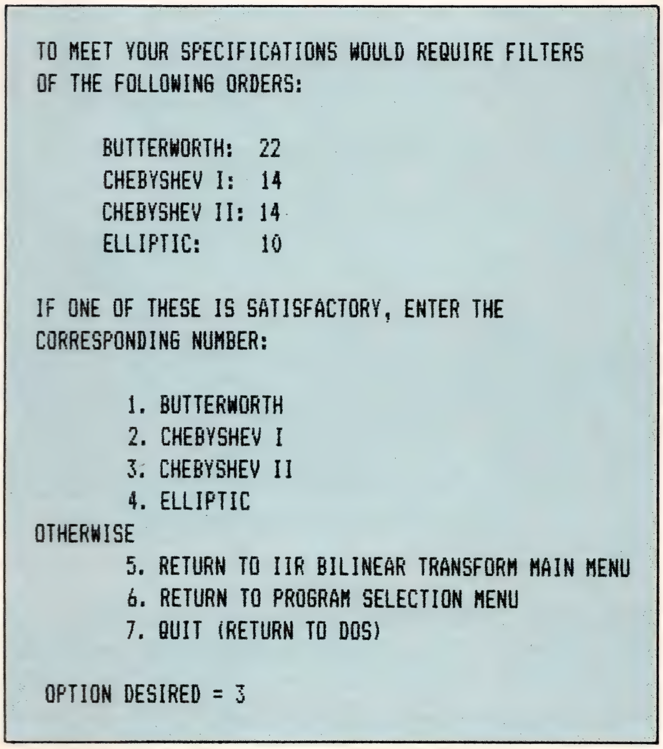
Demonstration disks are informative, but they don't exercise a program's full range of capabilities. By conducting a hands-on evaluation, you learn whether a package will work on your computer as you have configured it, whether you can obtain results right away, and whether the package continues to be useful as you ask more advanced design help from it. For our own hands-on evaluation we chose Atlanta Signal Processors' DFDP and Signix's Dispro.

Both the DFDP and Dispro packages are easy to install and produce results quickly. Both run on an IBM PC with 256k bytes of RAM and two floppy disks. Unlike so much of the latest engineering and scientific software, these packages don't need a hard disk and a math coprocessor, though at today's low costs, an 8087 is worth the investment. It's essential, of course, to have a color-graphics card and some sort of graphics CRT monitor (a B&W monitor will do).

We chose to exercise the programs by designing a 400-Hz notch filter, like the ones that might be used to reject power-generator noise in an airplane. We intended to use ours in a voice-quality audio system with a 10-kHz sampling rate. We initially specified a sharp notch in order to put the two programs to a good test, and the programs in turn taught us a thing or two about filter design.

Step by step, spec by spec

Typing "DFDP" brings up the Atlanta package, and typing "RUN" brings up the Signix package. From then on, it's mostly a matter of following the decision trees presented by sequences of screen menus. You don't have to follow the manual to start getting results from DFDP. (By contrast, we found it was necessary to work through Dispro's tutorial example before using Dispro with any confidence. In general, of course, it's a mistake to bypass the manuals if you intend to get the most out of a package.) DFDP takes you step by step through a filter design; it's therefore easy to use, but it allows you little choice in the order of tasks to be performed. Dispro is more flexible, or modular, allowing you to break out of the process and perform tasks in a sequence more to your liking. You can, however, increase the scope of DFDP if you buy the Whitman Madcap package, which treats DFDP like a utility.



```
TO MEET YOUR SPECIFICATIONS WOULD REQUIRE FILTERS
OF THE FOLLOWING ORDERS:

      BUTTERWORTH:  22
      CHEBYSHEV I:  14
      CHEBYSHEV II: 14
      ELLIPTIC:     10

IF ONE OF THESE IS SATISFACTORY, ENTER THE
CORRESPONDING NUMBER:

         1. BUTTERWORTH
         2. CHEBYSHEV I
         3. CHEBYSHEV II
         4. ELLIPTIC
OTHERWISE
         5. RETURN TO IIR BILINEAR TRANSFORM MAIN MENU
         6. RETURN TO PROGRAM SELECTION MENU
         7. QUIT (RETURN TO DOS)

 OPTION DESIRED = 3
```

Fig 1—This section of the DFDP program code *shows the program's estimation of the orders of standard IIR filters that will meet the specifications entered in a previous step. You then select a filter type by hitting the appropriate key.*

We first used DFDP to realize our notch filter in the form of an infinite-impulse-response (IIR) filter. DFDP consists of six IBM PC-DOS-type files, the most important of which are the three filter-design packages—one for IIR filters and two for finite-impulse-response (FIR) filters—and a code-generation program called CGEN, which converts the filter designs into source code for the TI 32010 DSP μP. Each of the three approaches to filter design has its own algorithm.

First you determine what type of filter you want to design. One keystroke selects the DOS file for IIR-filter design, which produces filters that are digital equivalents of the familar analog types. The IIR module then asks you what particular frequency-selective characteristics you desire for your filter. You select the bandstop characteristic appropriate for your notch.

Next, you enter the specifications of your design. We keyed in 10 kHz for our sampling rate and 390 Hz, 395 Hz, 405 Hz, and 410 Hz for the corners of our notch. We indicated that our notch stopband would spec 0.001

Unlike so much of the latest engineering and scientific software, digital-filter-design packages don't need a hard disk and a math coprocessor.

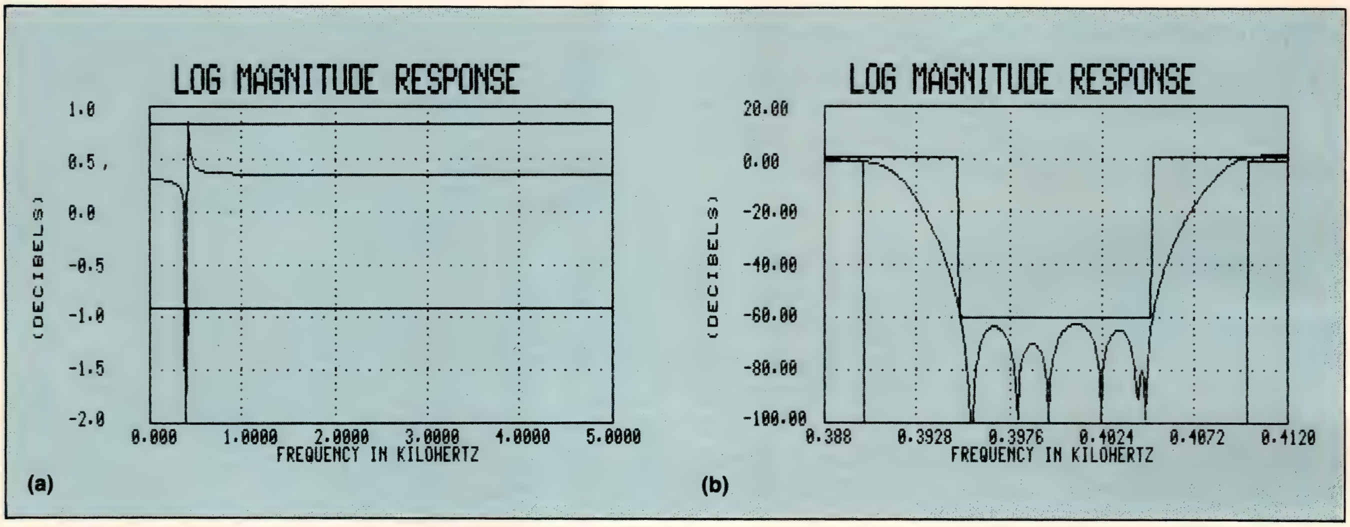


Fig 2—A basic log-magnitude plot of our IIR filter's notch (a) *does not show quite as much detail as we would like. DFDP can provide an "exploded" view of the notch* ***(b).***

attenuation (−60 dB), and its passbands would spec only 10% ripple. The program returns estimates for the orders of the standard categories of IIR filters that meet your specification. This data gives you an idea of how much program and data space your filter program will use in the DSP chip, and as a consequence you'll get a rough idea of the computation time required.

The program then asks you to choose which filter category you want **(Fig 1)**. We chose the Chebyshev II, reasoning that we wanted minimum ripple distortion in our main passband and didn't care how much ripple there might be in our stopband (as long as the stopband-attenuation spec was met). We learned later that either a Butterworth or Chebyshev I filter might have been a better choice.

Next, the program starts flashing its "WORKING" message, indicating that the design computation is underway. On our PC, the first stage of this computation took about two minutes. It would be an order of magnitude shorter, according to the company, for PCs having an 8087 coprocessor. In the absence of an 8087, the program, written in Microsoft Fortran, conducts a longer software simulation of the coprocessor.

At the end of this first stage, the program stopped and asked whether we wanted the filter coefficients quantized for the 32010 DSP chip. (DFDP is biased towards the 320 because the program was originally commissioned by TI.) We answered "yes," because we wanted to generate 32010 source code later.

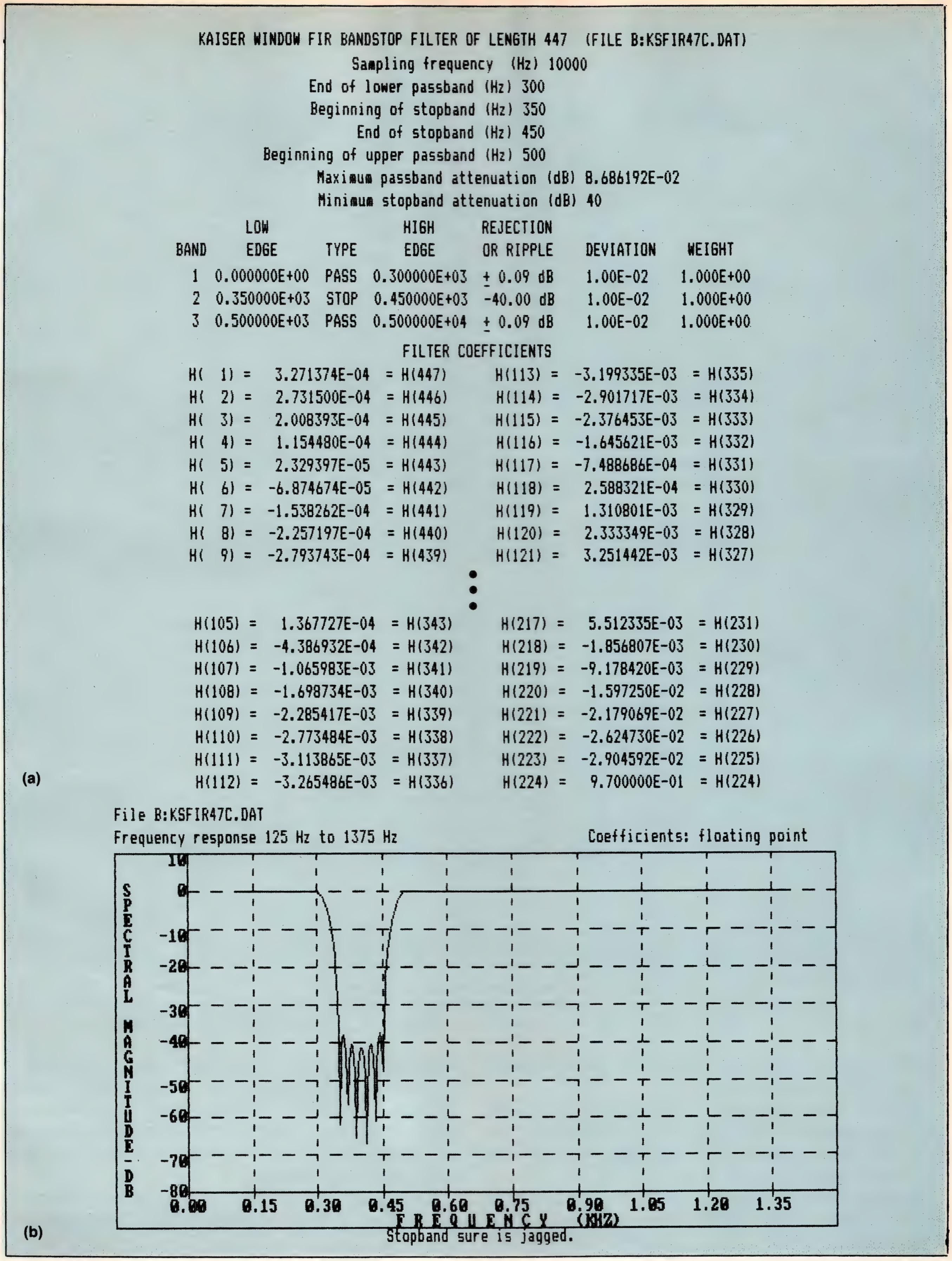
The "WORKING" message flashed for another two minutes. At the end of this period, the program delivered the specs of the filter that it has designed. It also gave us a discouraging message—that the filter did not meet our specifications. Part of the problem is that we had asked for the coefficients to be quantized for the 16-bit fixed points of the 32010. Even 24-bit floating-point accuracy might not have been sufficient to realize the attenuation we specified.

The program then displayed a wider range of choices. We could plot the design we had, or we could return to previous steps and adjust the parameters. Because we were simply interested in exploring the program's capabilities, we chose the first option and hit the appropriate key to plot results.

Plot options are extensive

The plot menu provides a rich selection of graphic analyses. We chose a basic log-magnitude plot. The initial full-scale plot did not show much detail **(Fig 2a)**, so we answered the program's prompt, "DO YOU WISH TO SEE EXPLODED VIEW?" in the affirmative to get a better look at the filter's frequency profile in the vicinity of the notch. It didn't meet our target specs, but it was not far off **(Fig 2b)**. A nice feature of DFDP is that it gives you a plot of your design just when you are most likely to want it. Dispro forces you to change program modules and prepare the plot.

Before leaving the plot section, we hit a key to obtain the impulse response of the filter design. We could tell at a glance how stable the filter was, ie, how quickly a transient died away and whether there might be a residual limit-cycle oscillation. Our design appeared to



(a)

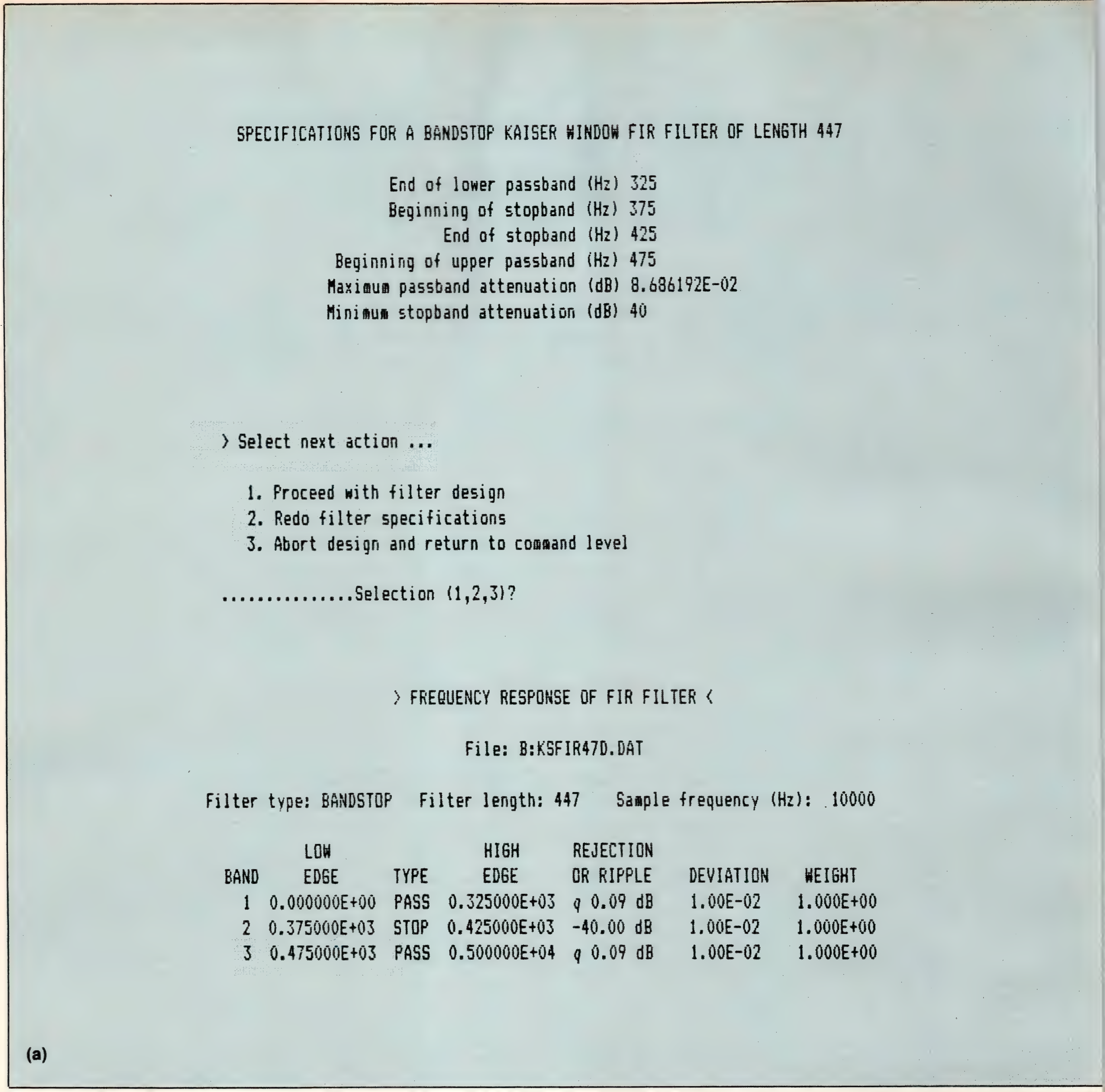
```
       KAISER WINDOW FIR BANDSTOP FILTER OF LENGTH 447  (FILE B:KSFIR47C.DAT)
                          Sampling frequency  (Hz) 10000
                      End of lower passband (Hz) 300
                      Beginning of stopband (Hz) 350
                           End of stopband (Hz) 450
                 Beginning of upper passband (Hz) 500
                       Maximum passband attenuation (dB) 8.686192E-02
                       Minimum stopband attenuation (dB) 40
              LOW                  HIGH       REJECTION
     BAND     EDGE      TYPE       EDGE       OR RIPPLE     DEVIATION    WEIGHT
       1  0.000000E+00  PASS  0.300000E+03   ± 0.09 dB      1.00E-02    1.000E+00
       2  0.350000E+03  STOP  0.450000E+03  -40.00 dB       1.00E-02    1.000E+00
       3  0.500000E+03  PASS  0.500000E+04   ± 0.09 dB      1.00E-02    1.000E+00
                              FILTER COEFFICIENTS
      H(  1) =   3.271374E-04  = H(447)     H(113) =  -3.199335E-03  = H(335)
      H(  2) =   2.731500E-04  = H(446)     H(114) =  -2.901717E-03  = H(334)
      H(  3) =   2.008393E-04  = H(445)     H(115) =  -2.376453E-03  = H(333)
      H(  4) =   1.154480E-04  = H(444)     H(116) =  -1.645621E-03  = H(332)
      H(  5) =   2.329397E-05  = H(443)     H(117) =  -7.488686E-04  = H(331)
      H(  6) =  -6.874674E-05  = H(442)     H(118) =   2.588321E-04  = H(330)
      H(  7) =  -1.538262E-04  = H(441)     H(119) =   1.310801E-03  = H(329)
      H(  8) =  -2.257197E-04  = H(440)     H(120) =   2.333349E-03  = H(328)
      H(  9) =  -2.793743E-04  = H(439)     H(121) =   3.251442E-03  = H(327)
                                         •
                                         •
                                         •
      H(105) =   1.367727E-04  = H(343)     H(217) =   5.512335E-03  = H(231)
      H(106) =  -4.386932E-04  = H(342)     H(218) =  -1.856807E-03  = H(230)
      H(107) =  -1.065983E-03  = H(341)     H(219) =  -9.178420E-03  = H(229)
      H(108) =  -1.698734E-03  = H(340)     H(220) =  -1.597250E-02  = H(228)
      H(109) =  -2.285417E-03  = H(339)     H(221) =  -2.179069E-02  = H(227)
      H(110) =  -2.773484E-03  = H(338)     H(222) =  -2.624730E-02  = H(226)
      H(111) =  -3.113865E-03  = H(337)     H(223) =  -2.904592E-02  = H(225)
      H(112) =  -3.265486E-03  = H(336)     H(224) =   9.700000E-01  = H(224)
```

(b)

```
File B:KSFIR47C.DAT
Frequency response 125 Hz to 1375 Hz                          Coefficients: floating point
```

Stopband sure is jagged.

Fig 3—The first Dispro run of the FIR filter for our 400-Hz notch *was quite long—447 taps—but it was still inferior in its amplitude-vs-frequency profile to the IIR notch generated by the DFDP program. The coefficients* ***(a)*** *are symmetrical about the center tap to give the desired linear phase characteristic. The log-amplitude-vs-frequency plot* ***(b)*** *indicates that the filter achieves better than the −40 dB specified in the middle of the notch where it's needed. Note that Dispro offers you the opportunity to annotate plots.*



```
SPECIFICATIONS FOR A BANDSTOP KAISER WINDOW FIR FILTER OF LENGTH 447

                End of lower passband (Hz) 325
                Beginning of stopband (Hz) 375
                      End of stopband (Hz) 425
          Beginning of upper passband (Hz) 475
         Maximum passband attenuation (dB) 8.686192E-02
         Minimum stopband attenuation (dB) 40



 > Select next action ...

    1. Proceed with filter design
    2. Redo filter specifications
    3. Abort design and return to command level

...............Selection (1,2,3)?



                  > FREQUENCY RESPONSE OF FIR FILTER <

                          File: B:KSFIR47D.DAT

Filter type: BANDSTOP   Filter length: 447    Sample frequency (Hz): 10000

          LOW                  HIGH       REJECTION
BAND      EDGE       TYPE      EDGE       OR RIPPLE    DEVIATION    WEIGHT
   1  0.000000E+00  PASS  0.325000E+03  q 0.09 dB    1.00E-02   1.000E+00
   2  0.375000E+03  STOP  0.425000E+03  -40.00 dB    1.00E-02   1.000E+00
   3  0.475000E+03  PASS  0.500000E+04  q 0.09 dB    1.00E-02   1.000E+00
```

(a)

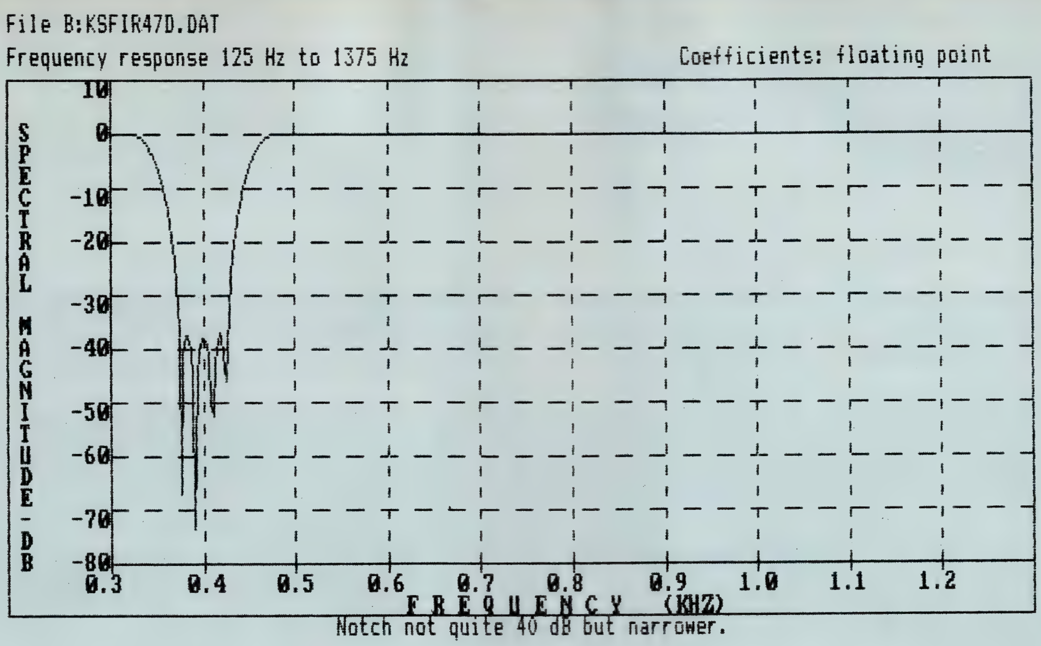
Fig 4—Reducing the FIR filter's stopband spec from 100 to 50 Hz (a) *resulted in comparable attenuation with the same number of taps (447);* ***b*** *and* ***c*** *show the narrower stopband and the 100-Hz stopband of* ***Fig 3b,*** *respectively. Dispro's ability to zoom in on graphic details, though adequate, was not as good as DFDP's. Often we would revert to Dispro's numeric printouts of amplitude for a finer look.*

have such a limit cycle at about 400 Hz, which, ironically, was our stopband.

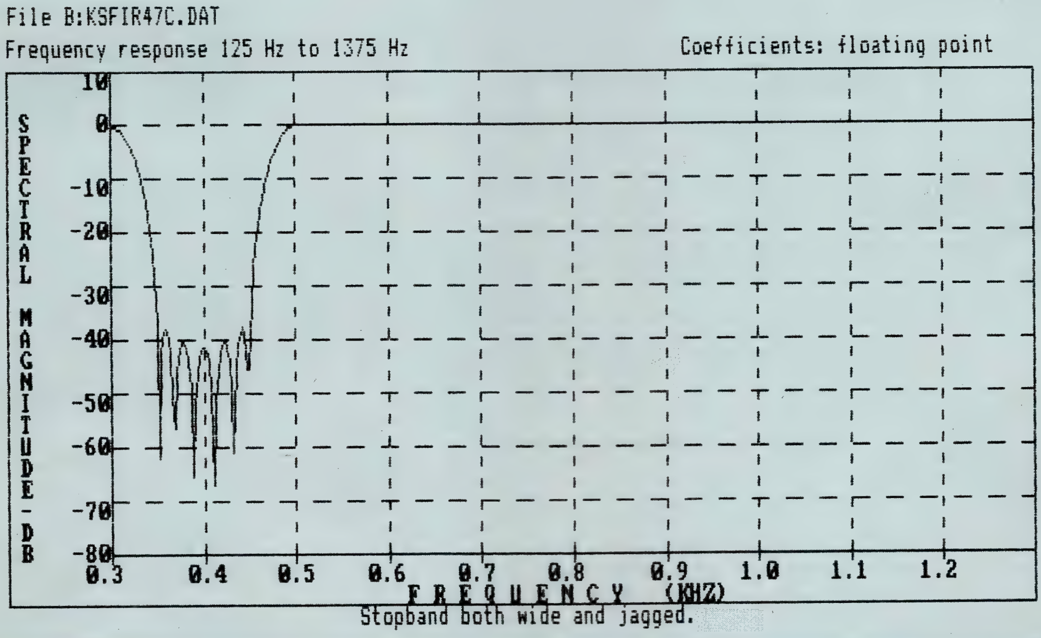
We next exited from the plot routine and wrote our IIR-filter design to one of the two DFDP disks. At this point we were through with our 1-pass design and returned to the command level.

Our next task was to gain access to the CGEN file, so that we could generate 32010 source code for the filter. The CGEN program asks you several questions as it prepares for its 32010 code generation: Where do you want to store the program? Where do you want to store the data? Where do you want the input to come from? Where should the output go? Where do you want the initialization routine? By hitting the return key in response to each question, you direct CGEN to assign the memory locations, etc, by default. Later, after you know more about your application's requirements, you can rerun CGEN to set up your own memory, input, and output assignments.

We next obtained the hard copy of the source code by exiting from DFDP and using DOS's TYPE command applied to the CGEN output. Then we could analyze how much memory space our IIR-filter code would require and how much execution time it would take. Of course, it had to be short enough that it would fit in the 32010's program-memory space and execute within the



(b)



(c)

sampling interval. For our application's 10-kHz sampling rate, the sampling interval is 100 μsec. Consequently, the 32010's 200-nsec instruction-execution time leaves room for 500 instructions. According to CGEN, the IIR filter will take up more than 200 of the 500 instructions, which is probably too high a price for the notch (it is, after all, a secondary function). We should relax the specs and see if we can pare down the filter's order. We might also want to investigate other coding and other algorithms for implementing the notch.

A nice feature of CGEN, as far as IIR filters are concerned, is that it automatically scales the gains of the biquadratic sections used in IIR filters so that overflow won't occur. This capability relieves beginners of the worry that the DSP computations might overflow, with disastrous results. Without this feature, a designer would have to go through an involved trial-and-error gain-adjustment process.

Another nice CGEN feature, which applies to both IIR and FIR filters, is that it's intelligent enough to decide when to substitute space-saving 32010 multiply-immediate (MPYK) instructions for full multiply (MPY) operations. MPYK instructions contain a shortened 13-bit version of the coefficient in their immediate field, so they don't need a 16-bit location in data memory, as do MPY instructions. CGEN checks whether the 13-bit truncation will affect the product; if not, it substitutes the MPYK instruction. Because our IIR filter had rather extreme performance demands, the design could use no MPYK instructions.

The reason it's possible to use automatic code genera-

Once you know more about your applications requirements, you can use the code-generation program to set memory, input, and output assignments.

tion is that the code for each of the filter types can be standardized. All IIR filters, for example, can use the same sequence of a given DSP chip's instructions: Only the coefficients need be different. One problem with automation, however, is that CGEN always gives you the same code pattern and doesn't allow you to make

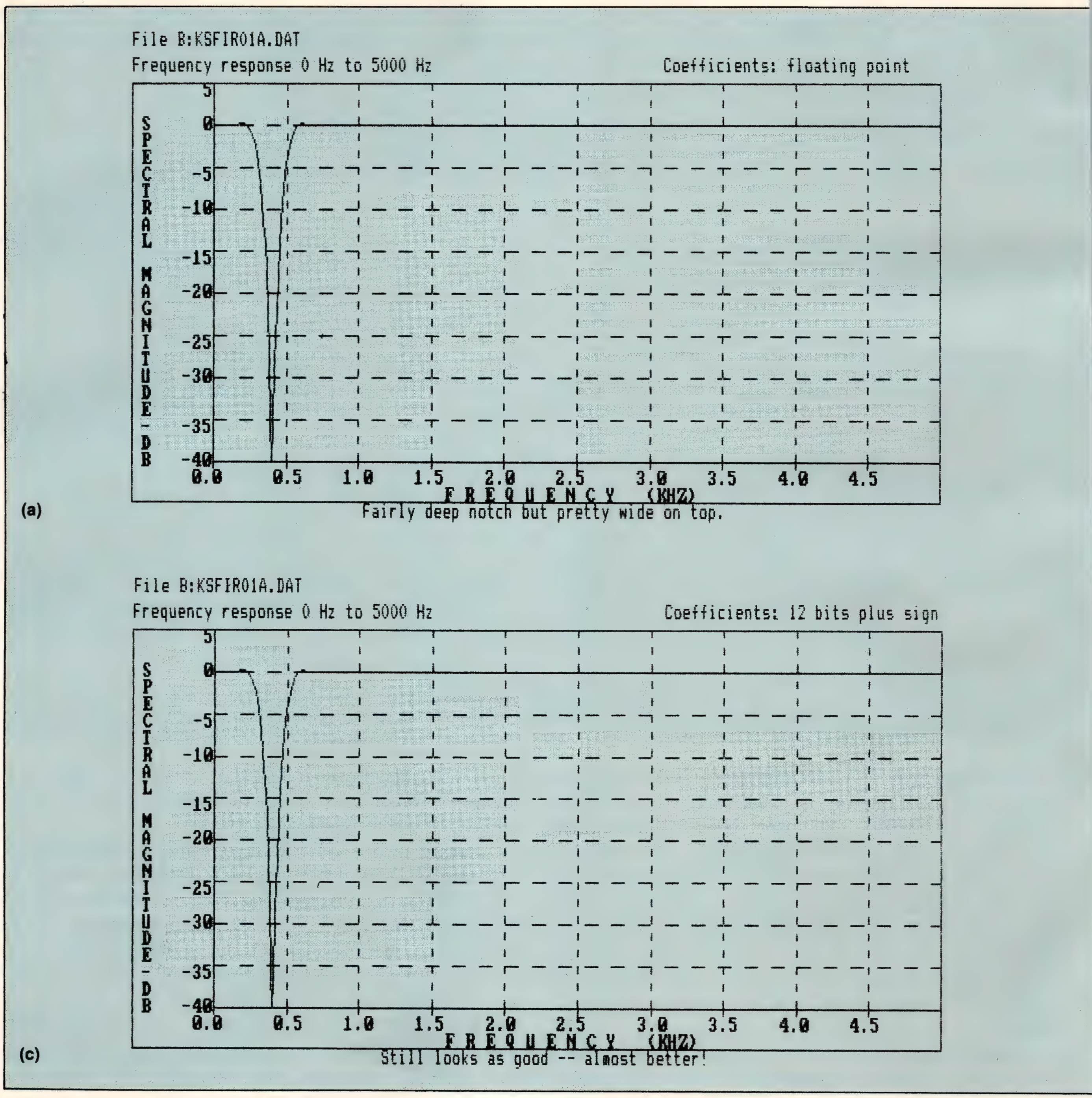
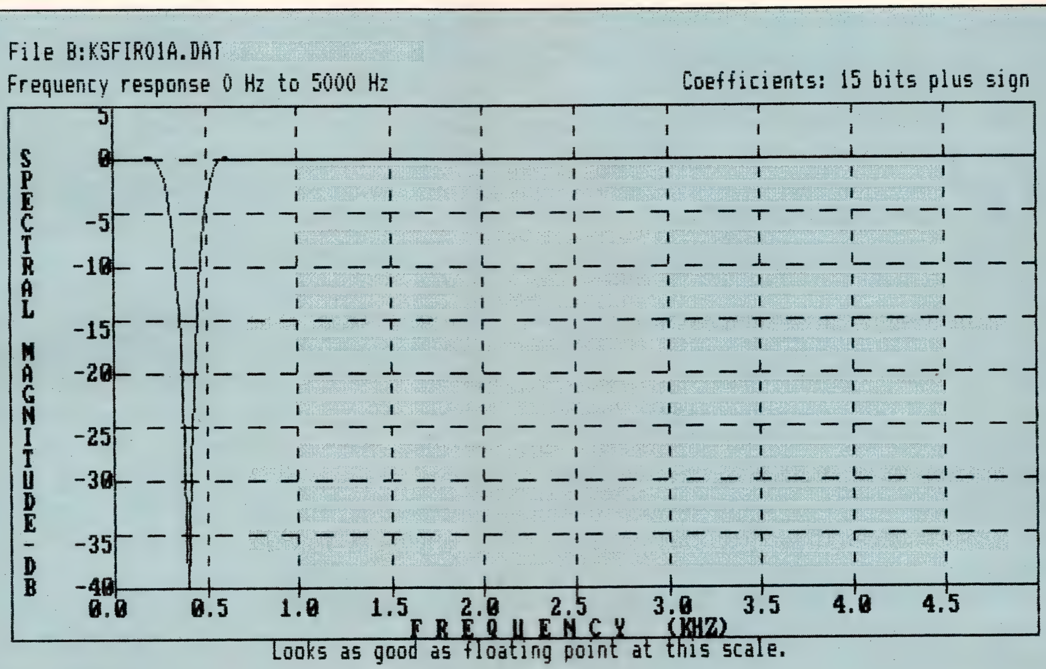


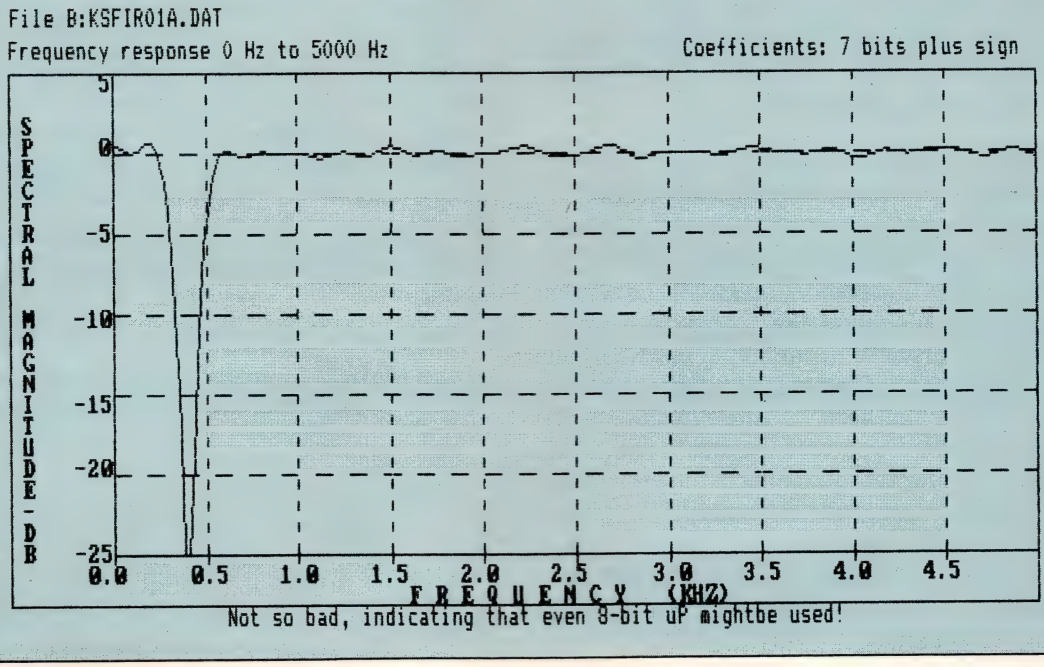
Fig 5—We changed our approach to the design of the FIR filter *by asking Dispro to give us a 101-tap FIR notch at 400 Hz. The program returned plots of several designs. Note how similar the plot of the 13-bit version (12 bits plus sign) is to that of the 24-bit floating-point design. The 8-bit version (seven bits plus sign), though degraded, might still prove useful in off-line applications employing low-end μPs.*

your own optimizations. For this reason, the fact that Dispro and other DSP design packages don't have the equivalent of CGEN doesn't prove to be a major shortcoming. Nevertheless, having CGEN is a convenience, especially when one connects 32010 development hardware to the PC, for then within an hour's time one



Looks as good as floating point at this scale.

(b)



Not so bad, indicating that even 8-bit uP mightbe used!

(d)

Neither of the filter-design programs tells you whether your specs represent intelligent tradeoffs between consumption of program space and sharpness of the notch.

can go straight from entering specifications to making test runs of code on the target system (if the hardware has emulation capability). Then any lingering doubts about the negative effects of 32010 coefficient size and 32010 arithmetic can be put to rest.

We used the Dispro package to realize our bandstop filter in the form of an FIR filter, a structure that looks like a tapped delay line with the weighted signals from the taps summed for the output. The objective of the design was to determine how many taps were needed and then to develop the weighting coefficients.

We chose a Kaiser-window-type FIR filter principally on the basis of expediency. The KFIR filter, as Dispro refers to it, computes in seconds, compared with much longer times for Parks-McClellan FIR (PMFIR) filters. (On the Atlanta program, because we did not have an 8087, a PMFIR filter could have taken hours.)

Initially, we attempted to develop an FIR filter with the same specifications we had used for our IIR filter. Dispro quickly indicated that such requirements would be impossible to realize, even if we used the maximum allowable KFIR filter length (measured in taps: 1000 for Dispro, 511 for DFDP). When we used DFDP to check FIR filter lengths for our notch, more than once the program falsely enticed us into proceeding with a design by indicating in its first estimation that a length shorter than what was really required would do the job. Only after performing several steps and time-consuming computations did DFDP notify us that the resulting filter didn't meet our specifications.

Programs don't present tradeoffs

We successively relaxed our notch's specifications to see what sort of FIR notch we could achieve. We found that neither of the filter-design programs tells you whether your specification choices represent intelligent tradeoffs between consumption of program space on the one hand and sharpness of the notch on the other. Note that in **Figs 3** and **4** both FIR filters have the same 447-tap length, and both have the same −40-dB attenuation for the stopband. But one has a very wide 100-Hz stopband, while the other has a shorter 50-Hz stopband. We had arrived at the 100-Hz-wide stopband first and then thought we'd check to see how much longer an FIR filter we'd need to cut the stopband in half. Interestingly, the same 447-tap length provides almost as good attenuation.

DSP experts, of course, are quick to assess these tradeoffs, because they have a much deeper understanding of the relationships involved. For example, when we described our results with the 447-tap FIR to John O'Donnell, the creator of Dispro, he explained that what we should have been looking at was the steepness of the transition bands, not just the width of the notch. Nevertheless, Dispro helped us explore many possible combinations of specifications rapidly and effortlessly.

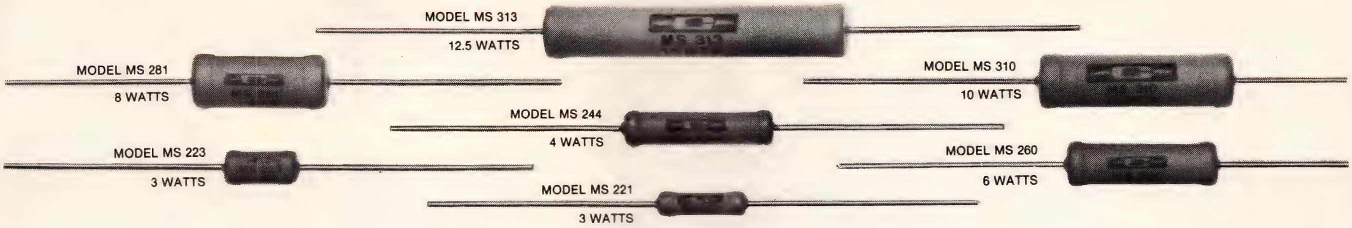
We soon realized that the code for all our filter candidates would be too long for the 32010 at the 10,000-Hz sampling rate, so we decided to use another Dispro option to attack the problem in another way. Instead of giving Dispro our specs and seeing what filter length it would produce, we told Dispro that we wanted a 101-tap KFIR filter (this type of FIR filter must have an odd length). In this mode Dispro asked us what stopband we wanted for our notch and we keyed in 380 to 410 Hz, with an attenuation of −30 dB.

Fig 5 shows various plots of notches based on these specifications. In addition to the basic floating-point design, there are plots for 15, 12, and seven bits (representing 16-, 13-, and 8-bit words when the sign bit is added). The results with rounded coefficients are of special interest to designers of DSP systems. They show that our code could employ the MPYK instructions of the 32010 with no appreciable loss in performance. They also show that, though no current 8-bit μP could run our filter code in real time, an 8-bit processor might still prove useful for removing 400-Hz noise from stored data.

One final note: We designed our filter with the TI 32010 DSP chip in mind, but what's really needed in these design packages is the ability to simulate the coefficient size and arithmetic manipulations of the many types of DSP chips now available. In addition, future packages should be able to simulate the performance of DSP systems composed of bit-slice components. **EDN**

Article Interest Quotient (Circle One)
High 473 Medium 474 Low 475

Type MS Non-Inductive Power Film Resistors from CADDOCK optimize high-speed power switching:



1. Caddock's "Non-Inductive Design" can improve rise and fall times to minimize losses in power switching circuits.

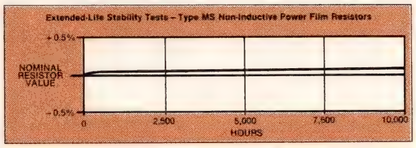
To keep the inductance to an absolute minimum, the special serpentine pattern provides for neighboring lines to carry the current in opposite directions to achieve maximum cancellation of flux fields over the entire length of the resistor.

The result is a truly non-inductive resistor that is about as inductive as a straight piece of wire the length of the resistor body.

This makes it possible for engineers to design new circuit configurations with superior non-inductive performance.

2. Extended-life stability that is typically better than 0.05% per 1000 hours.

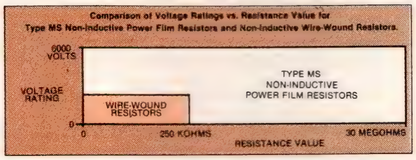
Extended load-life tests at full power have demonstrated typical stability better than 0.05% per 1000 hours.



Detailed stability data is included in the "Reliability Test Summary – Caddock Report #1" which is available on request.

3. Critical resistance values extended by higher voltage and power ratings.

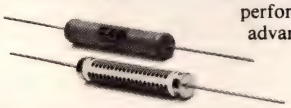
Caddock's Micronox® film resistor technology permits single-resistor voltage ratings as high as 6000 volts to be combined with power ratings of 12.5 watts at +25°C. This combination of power and voltage provides a critical resistance value of 2.88 Megohms - more than 10 times higher than can be achieved with wire-wound construction.



The higher voltage rating of Type MS resistors also overcomes the resistance value limits imposed on wire-wounds by the minimum wire size and spacing.

4. The special construction of Micronox® resistors assures high performance through harsh environments.

Type MS Power Film Resistors are produced by firing high-stability Micronox® resistance films directly onto a solid ceramic core - in air - at +1400°F to achieve a structure with these special performance advantages:



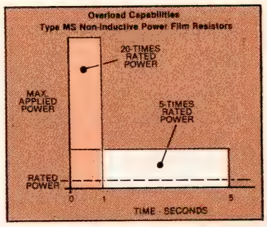
- Operating temperatures as high as +275°C.
- Repeatable temperature characteristics that include a TC of only 50 PPM/°C.
- Verified reliability through environmental extremes encountered in both 'down-hole' oil exploration and deep-space instrumentation equipment.

5. The family of Type MS Power Film Resistors includes 14 models with single-resistor values to 30 Megohms.

To overcome the construction *and* cost limitations inherent in wire-wound resistors, Caddock Micronox® film resistor technology gives circuit designers a *practical* balance between performance, value, size and cost, as the specifications for the Model MS 313 demonstrate:

- Non-inductive performance.
- 12.5 watt power rating.
- Resistance values from 50 ohms to 30 Megohms.
- Resistance tolerances from ±1.0% to ±0.1%.
- Maximum operating voltage of 6000 volts.
- Unit prices below $2.50 on 1000-lot orders for any value between 100 ohms and 200 Kohms.

6. Overloads of 5-times rated power for 5 seconds and 20-times rated power momentary are standard on all models.



After repeated power overload tests that apply 5-times rated power for 5 seconds, Type MS resistors have demonstrated stability typically better than 0.1%

For even higher overload situations, Type MS resistors can be subjected to 20-times the rated power for one second.

Caddock's advanced film resistor technology is the source of these outstanding advantages - advantages that are matched by a 20-year record of outstanding 'in-circuit' reliability.

Discover how easily these problem-solving resistors can improve the performance and reliability of your equipment, too. For your copy of the 20th Edition of the Caddock General Catalog, and specific technical data on any of the more than 150 models of the 13 standard types of Caddock High Performance Film Resistors, just call or write to -

Caddock Electronics, Inc., 1717 Chicago Avenue, Riverside, California 92507 • Phone: (714) 788-1700 • TWX: 910-322-6108

CADDOCK

HIGH PERFORMANCE FILM RESISTORS

CIRCLE NO 94

FAST MicroVAX Graphics

```
#include <std.h>
GLOBAL  UTINY   *scanwf8(startaddr, stopaddr
UTINY   *startaddr, *stopaddr, matchval;
{
        while ((startaddr <= stopaddr) && (*
            startaddr++;
        return(startaddr);
```

- **1280 x 1024 x 8 display (QG-1280)**
- **640 x 480 x 8 display (QG-640)**
- **35,000 vectors/second drawing speed**
- **1 million pixels/second image load**
- **3D accelerator SPACE MACHINE® option**
- **MicroVMS and RSX drivers**

Matrox now offers two new intelligent color graphics boards for the Q-Bus. The QG-1280 and QG-640 provide the speed and resolution necessary to upgrade DEC's MicroVAX and PDP computers into Professional Graphics workstations.

The QG-1280 has a resolution of 1280 x 1024. The board's drawing speed of 35,000 vectors/second means complex pictures are displayed in under a second. For solid modelling applications, an optional 3D accelerator module complete with Z buffer provides fast hidden surface elimination and shading.

The QG-640 is the perfect solution for OEM's requiring the same performance but with less resolution; 640 x 480, at 50% less cost.

Unlike conventional graphics terminals the QG-1280 and QG-640 ar directly accessible from the Q-Bus. There are no slow serial communication links. **You "see" results immediately.**

Let our new generation graphics boards "**speed up**" your workstation design — today.

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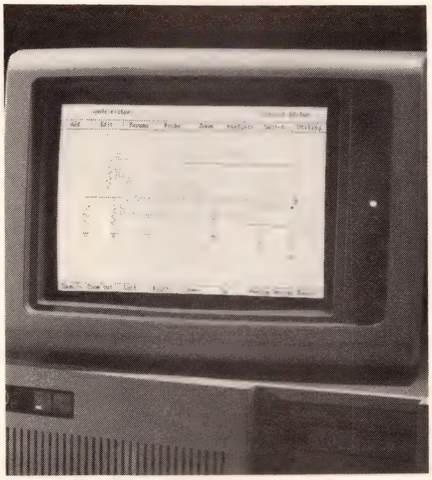
CIRCLE NO 146

Analog simulator for pc-board design runs on IBM PC-based CAE workstation



The PC Workbench package lets you construct an analog circuit, attach simulated test instruments, and view test results on a screen without building a breadboard circuit. The software, which is actually an upgrade kit for the PC, is similar to the vendor's Analog Workbench package that runs on Apollo, Sun, and Hewlett-Packard workstations, except that it doesn't have multiple viewing windows.

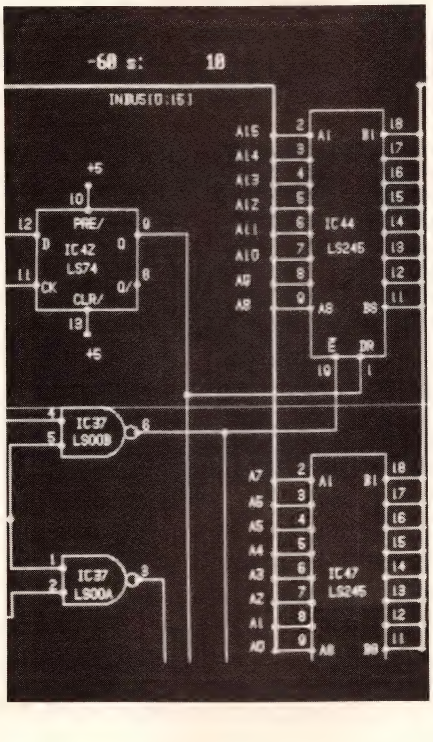
The package uses Spice Plus, an enhanced version of the Spice 3 program, to perform its simulations. Spice Plus operates under Unix V, and so the package requires a 32032 μP-based coprocessor board that provides this operating system. In addition to the 32032 μP, the coprocessor board contains 2M bytes of RAM.

Software functions include circuit editing, spectrum analysis, and parameter entry. Mock test instruments provide time- and frequency-domain measurements as well as dc analysis. To facilitate board design, you can select optional packages that contain either a 500-part or 50-part device library. Other options include parametric-plotting and statistical-analysis modules. The kit costs $12,500; options range from $2500 to $12,000.

Analog Design Tools Inc, 66 Willow Pl, Menlo Park, CA 94025. Phone (415) 328-0780.

Circle No 620

Low-cost package for personal computers automatically routes 16-layer pc boards



Three packages, Draftsman-EE, DC/Autorouter, and DC/Netlist, capture drawings, automatically route pc boards, and generate net lists, respectively. The programs run on IBM PCs and on the AT&T PC 6300.

Using IBM's enhanced graphics adapter, the Draftsman-EE graphics editor can produce 16-color, 640×350-pixel-resolution displays; in AT&T's high-resolution mode, it's capable of generating displays having 640×400-pixel resolution. Your design library may include pins, wires, buses, and traces as well as lines, arcs, circles, and traces. In addition, the editor offers orthogonal-rubberbanding and zoom capabilities.

DC/Autorouter can accept boards that have as many as 16 layers and that are as large as 32×32 in^2. A rat's nest display shows the origins and destinations of all interconnections. The autorouter package creates output files, which you can edit with the aid of Draftsman-EE. You can use HP pen plotters or Gerber Scientific Instrument photoplotters to produce final artwork.

DC/Netlist includes a net-list-compilation program and a net-list-linking program, Netcomp and Netlink. The package creates a list for each schematic page and includes common lines and bypass capacitors. Draftsman-EE costs $749; DC/Autorouter costs $2498; and DC/Netlist costs $295.

Design Computation Inc, 10 Frederick Ave, Neptune, NJ 07753. Phone (201) 922-4111.

Circle No 621

Software

Graphically oriented development tools design embedded-software applications

This set of computer-aided software engineering (CASE) programs, Structured Design Tools, automates the design of software for embedded-systems applications. The package displays software designs graphically, so you can partition your project according to a hierarchical structure and document the relationships among the components of the structure.

Structured designs use graphical notations to partition software modules, establish a hierarchy among the modules, and show data interfaces and control relationships. Structured Design Tools enables you to use structured-design techniques by automating the graphic functions of drawing and modifying diagrams.

To optimize program development, the package selects and organizes modules and module interfaces. You must define functions and data in a structured-analysis specification; the package then preserves your definitions for the design phase of your project.

A graphics editor helps you create and modify structure charts interactively. Using the editor, you can create, label, move, change, and delete each type of structure symbol on a chart. You can split or join diagrams, and you can also move groups of symbols. The package automatically follows connections to other parts of your diagram in other files.

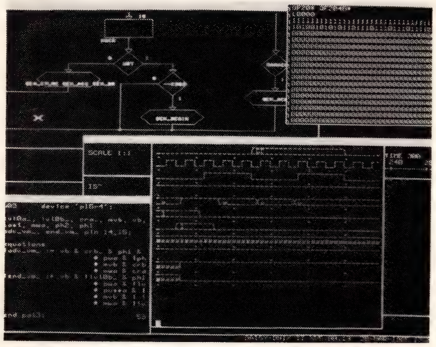
The program runs on the company's 856X software-development system, which includes an LSI-11/73 board, as well as on members of the VAX family of computers. Prices range from about $4500 to $9500, depending on the host computer.

Tektronix Inc, Box 14752, Portland, OR 97214. Phone (800) 342-5548; in OR, (503) 629-1573.

Circle No 619

Programmable-logic-device design package simulates and tests complete systems

PLD Master creates JEDEC code for PLDs (programmable logic devices). It runs on the manufacturer's Logician, Personal Logician, and MegaLogician engineering workstations—all of which include logic-verification software—and thus it can design, simulate, and test pc boards that contain PLDs and other digital components. The standard package includes three programming languages: Abel, Palasm, and Amaze. Any other PLD compiler that can generate a JEDEC file can also run on the system.



In addition to using high-level languages, you can enter design descriptions in the form of schematics, state-machine flow charts, and Boolean equations. Using this package, you can generate programming files for PLDs such as PALs, PROMs, fuse-programmable and field-programmable logic arrays, and programmable logic elements.

The package contains a data-management program that organizes all files in a project and that detects and flags errors in your PLD development sequence. Executing an autorun command accelerates the debugging process. When the program is in high-speed mode, you can tailor the default commands in your menu to suit your project. The package runs under the DNIX operating system and costs $6500. Shipping is scheduled to begin in August.

Daisy Systems Corp, 700 Middlefield Rd, Mountain View, CA 94039. Phone (415) 960-0123.

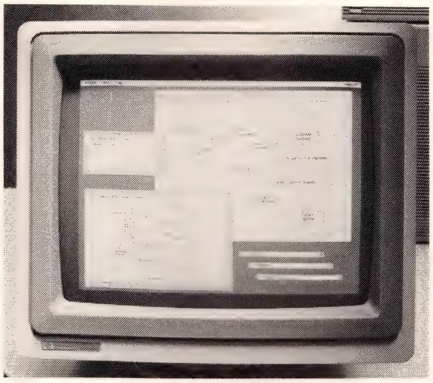
Circle No 623

Software

Computer-aided software-design package enforces consistency in code structures

HP Teamwork/Structured Analysis provides computer-aided support for the specification phase of software development. The software is licensed from Cadre Technology (Providence, RI) and runs on the 9000 Series 300 workstations. For µP-code development, you can combine the specifications this program produces with the HP 64000 logic-design system's editors, cross compilers, and assemblers.

The package includes a library, editor, consistency checker, and annotator. A project library serves as the central database for all workers on a specific project. This library includes data dictionaries, data-flow diagrams, process specifications, annotations, and project-management data.



The package's graphics editor enforces rules for building data-flow diagrams and specifies their relationships to other objects. Further, the editor manipulates models and other system entries only in accordance with these rules.

The consistency checker detects specification errors within and between data-flow diagrams, data-dictionary entries, and process specifications. The program manages model configurations that allow the collection of data-flow diagrams into sets. You can initiate analysis at any level in the set and then proceed from there—either up or down the model set.

If your program includes information that's necessary to your system model but doesn't fit into the standard structured model, an annotator can capture and store that information. HP Teamwork/Structured Analysis is priced at $8500. Delivery, 12 weeks ARO.

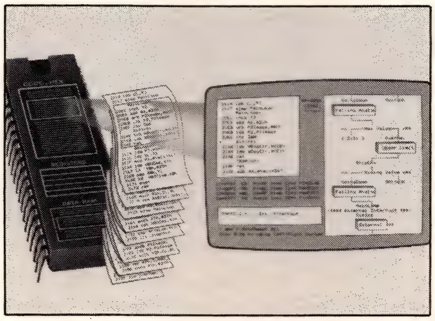
Hewlett-Packard Co, 1820 Embarcadero Rd, Palo Alto, CA 94303. Phone local office.

Circle No 622

Debugger, simulator, and crossassembler can embed I/O commands in source code

The Sim8096 debugger allows designers to debug 8096 code on IBM PCs, PC/XTs, and PC/ATs. The multiwindow display of the personal computer shows the source code, registers, stack, memory locations, timers, I/O ports, and pins. It also documents the program flow.

You can scroll through the source code without executing it, single-step through the code, or run full speed until you reach a breakpoint. You can also set register traps. The debugger allows you to embed I/O stimulus commands in the source code itself, so you can exercise various I/O routines during stepping.



At any time, you can choose to issue I/O commands from your keyboard. The package gives you access to the internal structures such as the A/D converter, the FIFO, the UART, various timers, and the interrupt structure. After debugging a program, you can dump the flowgraph and trace code to the system printer, thereby providing clear documentation for the code.

In addition to the debugger, the company offers the Cys8096 crossassembler for the IBM PC and an EPROM programmer that interfaces to an IBM PC RS-232C port. You can use the same hexadecimal file for debugging and for programming EPROMs. Cys8096 crossassembler, $295; EPROM programmer, $245; Sim8096 debugger/simulator, $995; Sim8096 demonstration package, $39.50.

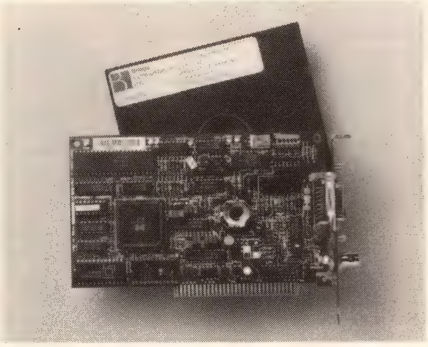
Cybernetic Micro Systems, Box 3000, San Gregorio, CA 94074. Phone (415) 726-3000. TLX 171135.

Circle No 624

Terminal-emulation software package expands emulation capabilities of IBM PCs

Using this PC-DOS terminal-emulation and file-transfer program, EtherTerm version 1.2, you can emulate a range of CRT terminals with your IBM PC or compatible computer. The package runs on personal computers equipped with 3Com Corp's EtherLink network-controller board. (This board links personal computers to an Ethernet LAN.)

The package handles third-party emulation programs by replacing the IBM PC's BIOS interrupt 14H interface routines with its own interface code. The terminal emulator redirects interrupt calls from the PC's serial port, which allows the emulation program to communicate with terminals from Honeywell, Hewlett-Packard, and Prime, among others.



The vendor has validated a number of third-party programs for the package. Included in the list of approved software are programs from Walker, Richer, & Quinn (for DEC's VT220 and the HP 2392 and HP 2623 terminals), Grafpoint (for Tektronix's 4105), and Performance Consulting Group (for Data General's Dasher 210).

The software package permits PCs to access asynchronous ports, 3270 SNA sessions, X.25-based public data networks, and modem pools. PC-to-host file transfers can use either text or XModem file-transfer protocols.

In addition to the EtherLink network-controller board, your personal computer must have an 80-column display, 256k bytes of memory (or more), and PC-DOS version 2.0 (or later). The program can use either fiber-optic cable or standard or thin Ethernet coaxial cable. EtherTerm 1.2 costs $300 for a single-user version; a server version that can handle as many as 20 personal computers lists for $1500.

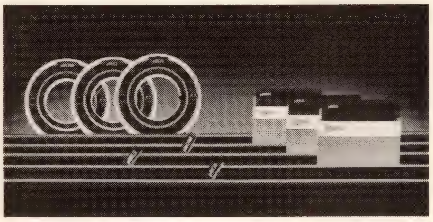
Bridge Communications Inc, 2081 Stierlin Rd, Mountain View, CA 94043. Phone (415) 969-4400. TLX 176544.

Circle No 627

Real-time operating-system software eliminates source-code manipulations

The pSOS-68020 real-time multitasking kernel, the pHILE-68020 file manager, and the pROBE-68020 system debugger/analyzer form a family of real-time software components for the Motorola 68020 32-bit μP. Each component is a plug-in object-code module that operates independently of its target hardware, memory location, or application.

The pSOS-68020 supports dynamic creation and control of processes, message queues, multiple-event synchronization, dynamic allocation of variable- and fixed-size memory blocks, timing functions, and an I/O supervisor for user-installed drivers. The program occupies 5k bytes of code. Its worst-case interrupt response is 15 μsec, and a complex system call with a process switch takes less than 120 μsec.



The pHILE-68020 provides contiguous allocation, record locking, and selectable cache write-through features. It fits in 16k bytes of code and operates with any device.

The pROBE-68020 is an analysis and integration tool for pSOS-based applications. It provides windows to view processes, queues, and other objects, and breakpoints that trigger on system activities such as state transitions, qualified system calls, and I/O operations. A profiler is included.

All three products are upward compatible with versions that support the 68000 and 68010 μPs. Each unit costs $3000, including 10 binary copies and one year of maintenance and support.

Software Components Group, 4655 Old Ironsides Dr, Suite 370, Santa Clara, CA 95054. Phone (408) 727-0707. TLX 757697.

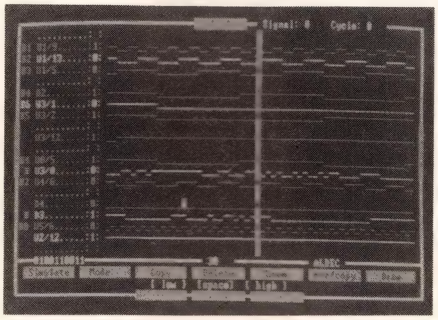
Circle No 628

Software

Hardware-development tools link μPs, arrays, and PLAs

The Master Schematic logic analyzer and companion products let you create μP-based, PLA-based, or gate-array designs from schematics. The logic analyzer provides schematic-capture capabilities for IBM PCs and compatible computers. Its output can be μP code, ANSI PLA program files, or Fujitsu-compatible gate-array files.

The logic analyzer and its suite of options—which include graphics schematic capture, Alice (Aldec logic in-circuit emulator), the Logic Networking Compiler, and various libraries—run on an IBM PC with an enhanced graphics adapter. The Master logic analyzer costs $2850; both net-list and logic-equation entry are available. The graphics schematic-capture option costs an additional $1600. Libraries of standard ICs (such as 7400 TTL or CMOS) cost around $1250 each.



The Master analyzer includes an interactive simulator, which runs on a standard IBM PC without any need for a coprocessor board. The simulator lets you set inputs and breakpoints and monitor outputs or circuit nodes. The analyzer can break a large schematic into segments and produce different types of output for each segment. A $3000 option, the Logic Networking Compiler, produces code for multiple parallel μPs to replace circuits too complicated for a single processor.

The Alice hardware/software package allows you to connect the design you created on the PC to its intended hardware environment, enabling you to debug your design before building it. The Alice hardware includes PROM and 8751 programmers, 32 digital output lines, and 32 digital input lines. The hardware/software package costs $3900.

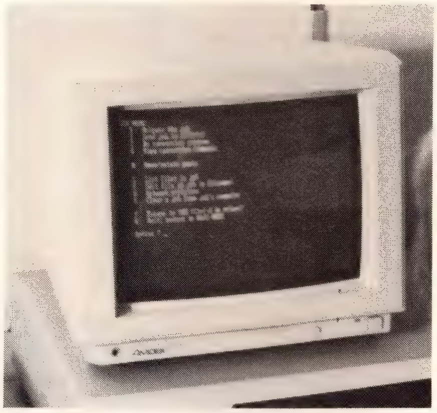
Aldec-Automated Logic Design Co, 3525 Old Conejo Rd, #111, Newbury Park, CA 91320. Phone (805) 499-6867.

Circle No 625

LAN software package interconnects CAE, CAD, CAM, and ATE systems

A software package called Network automates the flow and coordination of design data throughout a product's design cycle. It can convert and transfer data automatically among CAE, CAD, and CAM equipment as well as ATE.

Because the package can move data among different databases, it eliminates the need for manual reentry of data and lets you connect otherwise incompatible systems. The software also coordinates the release of jobs, revisions, and engineering changes. A computer-integrated-manufacturing program issues, via the LAN, memos that inform authorized individuals of a design's current status.



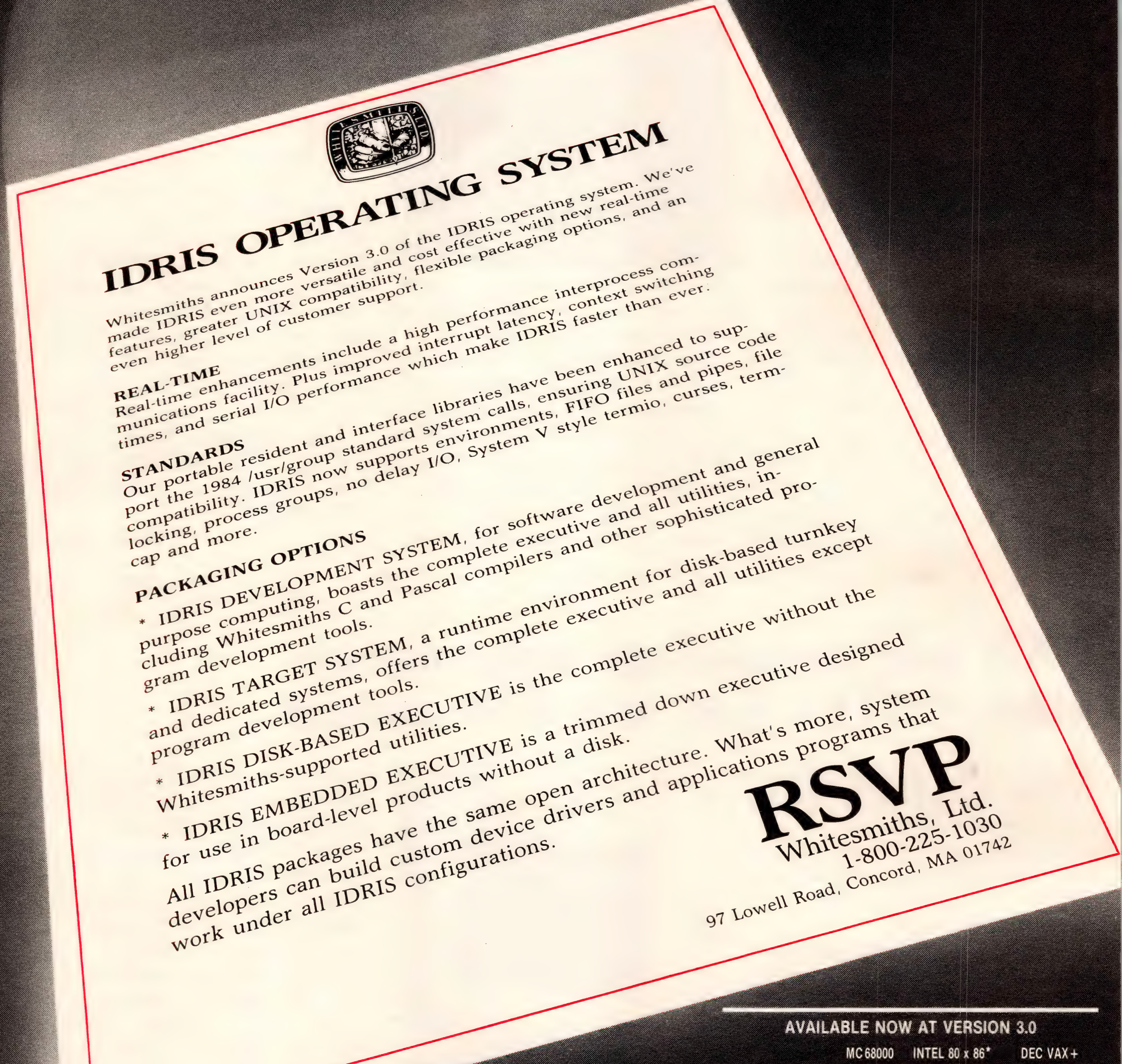
To use this interface software, you must select conversion programs for your CAD/CAM equipment. Conversion packages are available that translate generic part names to company-specific part names, interconnect dissimilar computers on a LAN, and link automated equipment to hosts.

The interface package operates under QNX, a system that's similar to Unix, and runs on IBM PCs and compatible personal computers. It uses Ethernet for LANs; a wide-area network may comprise RS-232C interfaces, modem connections, and Western Union's EasyLink. Prices vary with configuration; a 5-node LAN that includes three conversion programs costs $40,000.

DA Systems Inc, 1503 E Campbell Ave, Campbell, CA 95008. Phone (408) 559-7374.

Circle No 626

An Invitation To Meet The IDRIS Team



IDRIS OPERATING SYSTEM

Whitesmiths announces Version 3.0 of the IDRIS operating system. We've made IDRIS even more versatile and cost effective with new real-time features, greater UNIX compatibility, flexible packaging options, and an even higher level of customer support.

REAL-TIME
Real-time enhancements include a high performance interprocess communications facility. Plus improved interrupt latency, context switching times, and serial I/O performance which make IDRIS faster than ever.

STANDARDS
Our portable resident and interface libraries have been enhanced to support the 1984 /usr/group standard system calls, ensuring UNIX source code compatibility. IDRIS now supports environments, FIFO files and pipes, file locking, process groups, no delay I/O, System V style termio, curses, termcap and more.

PACKAGING OPTIONS

- * IDRIS DEVELOPMENT SYSTEM, for software development and general purpose computing, boasts the complete executive and all utilities, including Whitesmiths C and Pascal compilers and other sophisticated program development tools.
- * IDRIS TARGET SYSTEM, a runtime environment for disk-based turnkey and dedicated systems, offers the complete executive and all utilities except program development tools.
- * IDRIS DISK-BASED EXECUTIVE is the complete executive without the Whitesmiths-supported utilities.
- * IDRIS EMBEDDED EXECUTIVE is a trimmed down executive designed for use in board-level products without a disk.

All IDRIS packages have the same open architecture. What's more, system developers can build custom device drivers and applications programs that work under all IDRIS configurations.

RSVP

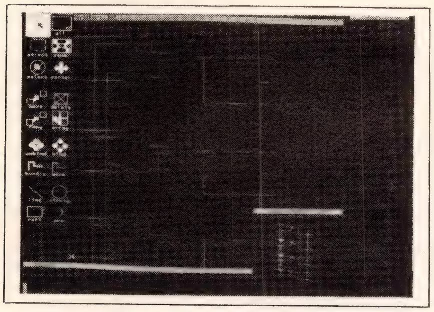
Whitesmiths, Ltd.
1-800-225-1030
97 Lowell Road, Concord, MA 01742

AVAILABLE NOW AT VERSION 3.0

	MC 68000	INTEL 80 x 86*	DEC VAX +
DEVELOPMENT SYSTEM	X	X	X
TARGET SYSTEM	X	X	X
DISK-BASED SYSTEM	X	X	X
EMBEDDED EXECUTIVE	X		

* Cohabitates with DOS
+ Cohabitates with VMS

CIRCLE NO 147



SCHEMATIC EDITOR

The Ace schematic editor and the Ace PI procedural interface to this company's design database can help you integrate incompatible CAE tools and design information. The packages run on all workstations in the company's product line. To create drawings with the schematic editor, you select icons that represent functions and click your mouse. Other features of the schematic editor include wire rubberbanding, MIL-Spec drawing, unlimited Undo commands, and freehand creation of custom components.

The interface is a set of Pascal calls that enables you to read or write data to or from the schematic database. You can use this program to transfer schematics from other workstations to the company's systems; you can also alter schematics and create custom software that checks or modifies schematics.

The editor requires a bit-mapped graphics board (which some of the manufacturer's systems already include); the program itself is free. This board ranges in price from $2000 to $8000. Site licenses for Ace PI cost $50,000.

Daisy Systems Corp, 700 East Middlefield Rd, Mountain View, CA 94039. Phone (415) 960-0123.

Circle No 629

CAE ON MACINTOSH

Using Designscope, you can simulate circuits on an Apple Macintosh computer. The program lets you assign parameters to electronic blocks and then assemble the blocks into a schematic diagram. After you have constructed a schematic, the package simulates the system and displays the resultant waveforms. Analog component blocks available in the package include amplifiers, comparators, filters, phase-locked loops, voltage sources, integrators, differentiators, and rectifiers. In addition, the package provides models for log-exponential amplifiers, mutipliers, peak detectors, S/H circuits, delay lines, noise generators, transient generators, and clippers. For digital designs, the package offers logical gates. Other digital functions include flip-flops, frequency dividers, and one-shot devices. $249.95.

Brainpower Inc, 24009 Ventura Blvd, Suite 250, Calabasas, CA 91302. Phone (818) 884-6911.

Circle No 632

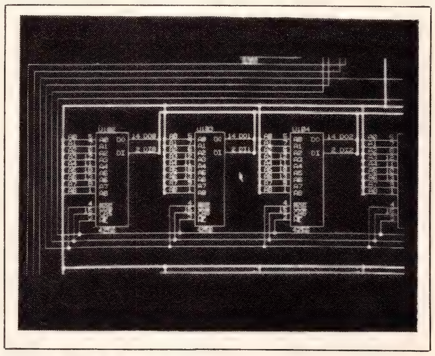
PC-BASED CAE/CAD

The EE Designer consists of three integrated programs that capture schematics, simulate logic, and lay out pc boards, respectively. In helping you plan a placement and routing strategy, the schematic-capture program places components so that the layout minimizes routing paths; the program then displays rats-nest connections. A back-annotation feature updates the schematic with changes in the layout.

The logic simulator lets you select as many as 12 logical states during a simulation; the program can force signals to predefined states, or it can randomly initialize the state of storage elements like flip-flops. The circuit-simulation library provides logic models for 150 TTL and CMOS devices. The layout program produces artwork masters for pen plotters, photoplotters, and N/C drill tapes. The package runs on all IBM PCs and compatible personal computers that contain 512k bytes of memory. You can control the package's graphics with either a standard IBM color board or a 640×400-pixel Tecmar graphics board. $975. Thirty-day money-back guarantee.

Visionics Corp, 1284 Geneva Dr, Sunnyvale, CA 94089. Phone (408) 745-1551.

Circle No 630



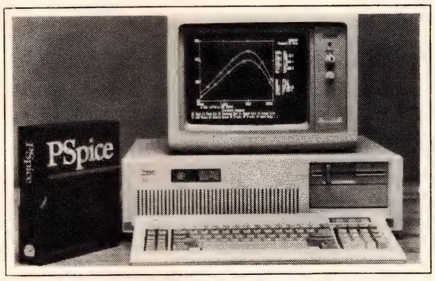
SCHEMATIC DESIGN

Running on an IBM PC or compatible computer, this company's SDT schematic-capture program allows you to place parts, wires, text, and other objects on a screen via keyboard or mouse commands. You can move, rotate, replicate, and delete selected parts. Possible worksheet sizes range from A to E.

The package features hierarchical schematic organization and rubberbanding of wires, buses, and blocks. An on-line, 1200-part library contains TTL and CMOS devices, memories, discrete components, μPs, and peripherals. The package provides four utility programs: schematic-output generation, net-list creation, design checking, and bill-of-materials file. You can suspend a session and switch to DOS command execution. It requires MS-DOS, version 2.0 or higher; a 360k-byte floppy-disk drive; and 256k bytes of RAM. $495.

Orcad Systems Corp, 1049 SW Baseline St, Suite 500, Hillsboro, OR 97123. Phone (503) 640-5007.

Circle No 631



COMPONENT LIBRARY

You can use the Parts option for the PSpice circuit simulator to develop models of bipolar transistors, diodes, op amps, and voltage comparators. Using data-sheet information from a component manufacturer, the package can create device models. The software can also generate best- and worst-case models for device-parameter and operating-temperature variations. The interactive package, which runs on IBM PCs, produces hard copy for most dot-matrix printers and pen plotters. $450.

MicroSim Corp, 23175 La Cadena Dr, Laguna Hills, CA 92653. Phone (800) 826-8603; in CA, (714) 770-3022.

Circle No 634

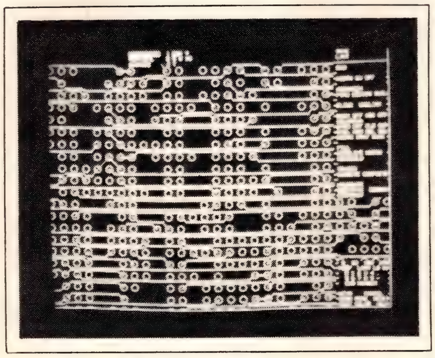
AI LANGUAGE

This dialect of the Lisp programming language, PC Scheme, lets you develop artificial-intelligence applications programs on either an IBM or a Texas Instruments personal computer. The language specializes in such tasks as symbolic computing. A key feature of this language is its optimizing compiler, which produces code that executes programs from three to 10 times as fast as interpretative Lisp programs, according to the vendor.

The language provides features for debugging errors, controlling graphics, and creating windows. A subprogram helps you develop object-oriented applications packages. If you need to execute an MS-DOS program, you can suspend operations in the language, switch into the operating system, and then return to the programming language. The minimum memory requirement is 320k bytes, but more memory and a hard disk are usually necessary for software development. $95.

Texas Instruments Inc, Data Systems Group, Box 809063, H-833, Dallas, TX 75380. Phone (800) 527-3500.

Circle No 633



PC-BOARD ROUTER

The Look Out router, which is part of the Scicards package, features a gridless algorithm and can route one, two, three, or more traces between pin pads. To set the channel and spacing, you specify only the component pad size. The program can bend traces in channels; it doesn't violate layer-direction preference rules. Before it places any traces, the router explores all routes, analyzes all channels, and determines the best via locations. $25,000 for Scicards package.

Scientific Calculations Inc, 7635 Main St, Fishers, NY 14453. Phone (716) 924-9303. TWX 510-254-8546.

Circle No 636

FILTER DESIGN

Two filter-design programs can help you develop filters for microwave circuits. Edge-Coupled Stripline (ECS) and Edge-Coupled Microstrip (ECM) design filters and analyze filter responses. If you need to change the parameters, the programs offer an option that automatically reconfigures filter designs. Design parameters include input bias, choice of materials, parasitic capacitances, empirical corrections, insertion losses, phase and time delay, impedance, and admittance.

You can use these programs with Touchstone, the manufacturer's linear-circuit design simulation and optimization program, which can plot filter characteristics. From $3500 to $7500 each, depending on options selected.

EEsof Inc, 31194 La Baya Dr, Westlake Village, CA 91362. Phone (818) 991-7530. TLX 384809.

Circle No 635

PROTOCOL SOFTWARE

You can now obtain two additional software layers of the GM-MAP/International Standards Organization (ISO) communication network protocol. The ISO session protocol, layer 5, is a C language implementation of the basic combined subset of the ISO/DIS8326 session specification. Using this protocol, you can establish connections, exchange data, and release the connection in an orderly manner. The session protocol interfaces directly to the company's TP4 transport protocol.

Also available is the layer 2 high-level data-link control (HDLC) protocol. The C language implementation of the data-link protocol supports the balanced class of HDLC; it's compatible with the extended-sequence numbering that uses the 1984 version of X.25 link-access procedures balance (LAPB). One-time source license fee for the session protocol, $6000; for the HDLC protocol, $5000.

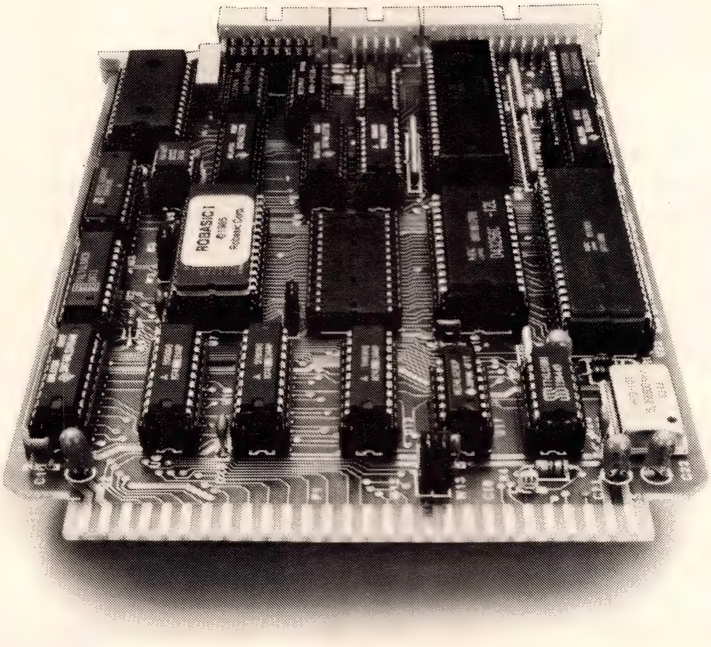
Syros Inc, 1050 E Southern, Suite B-3, Tempe, AZ 85282. Phone (602) 966-2661.

Circle No 637

DATABASE MANAGER

By using an indexed sequential-access method for locating and retrieving data records, the Data Base Manager eliminates the need to insert operating-system calls for file manipulation. The software sub-

Software and Multifunction... A control system on a card.



MULTITASKING ROBASIC™ SOFTWARE
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SERIAL PORT—RS-232C, 16 DIGITAL CHANNELS
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For the first time on the STD Bus you can get software AND multifunction on one card. Octagon's new 886 CPU provides you with a system solution that is designed for process control, test and measurement, data acquisition, environmental control, robotics and other industrial applications.

This new CPU card gives you analog inputs, digital inputs/outputs, high current drivers, a serial port, 32K bytes of RAM, space for autorun programs and a multitasking language called ROBASIC.

ROBASIC is a resident, compiled language that addresses real-time control and measurement problems. It uses familiar Basic commands but runs faster than Basic. Plus, there are 73 extended commands that specifically talk to STD Bus peripheral cards. Its speed, simplicity and special commands make it easy for anyone to write control programs.

When combined with a low cost 871 EPROM Programmer card, a power supply, and a CRT terminal or your IBM PC, the 886 becomes a complete development system. You can now write, debug and store your programs. And, they will automatically execute on power up. It's that simple.

Octagon provides an experienced technical support staff that will walk you through every step of your application. There is also a two year warranty to back up every Octagon product.

For more information on the 886 and other Octagon STD Bus products please call **303-426-8540.**

OCTAGON SYSTEMS
CORPORATION

6510 W. 91st Avenue
Westminster, Colorado 80030

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CIRCLE NO 113

system provides high-level commands that can store, update, and retrieve data. The command set includes: Open or Close Data Base; Read, Write, Rewrite, or Delete Record; Read Next or Previous Record; and Purge or Create Database.

To access records within a database, you must select a 32-bit key value from an index. The database manager sorts index records according to these key values; the software subsystem also maintains the index. Although the index and data files coexist in one database, the files remain distinct.

Because this product includes the source code, you can configure the software easily. Configuration options include defining the memory model, the size of key values, and the number of open databases. The program is available on 5¼-in. floppy disks in MS-DOS, iRMX-86, and PC-RTX formats for $495.

CompuFirm Corp, 7677 Ronson Rd, San Diego, CA 92111. Phone (619) 571-0228.

Circle No 638

LINEAR-IC DESIGN

Linear CAD II, a linear-design program, runs on IBM PC/XTs or PC/ATs that contain 512k bytes of RAM and an 8087 math coprocessor. In addition to the 17 previously available macrocells, the package now includes the vendor's 12 latest linear macrocells. Among these cells are a video amplifier that's functionally equivalent to the NE592 and a timer macrocell that is functionally equivalent to the NE555.

The program also now provides models of the company's 12V linear bipolar process. The software includes Case Technology's schematic-capture software as well as MicroSim's PSpice circuit simulator, which can automatically handle substrate and epitaxial-tub bias. A postprocessor displays PSpice output on your computer's screen. A file-management structure optimizes the use of disk space; you can access DOS directly from the graphics editor. $10,000.

Micro Linear Corp, 2092 Concourse Dr, San Jose, CA 95131. Phone (408) 262-5200.

Circle No 639

REAL-TIME MONITOR

The C Executive real-time monitor can use the Intel 80386 and 80286 μPs for real-time applications. Further, the monitor can interface to Intel's 8080, 8085, 8086, 8088, and 80186 μPs, as well as to the Zilog Z80; DEC's LSI-11; Motorola's 6809, 68000, and 68010; the National Semiconductor Series 32000; and AT&T's WE32100. Switching times spec 87 μsec on a 10-MHz 68000 and 68 μsec on an IBM PC/AT that uses a 6-MHz 80286.

An optional file system lets you use floppy and hard disks in conjunction with the μPs. In addition, you can configure a section of your computer's memory as a RAM disk. Both contiguous and noncontiguous file structures are available. C Executive, $500; optional file system, $250.

JMI Software Consultants Inc, Box 481, Spring House, PA 19477. Phone (215) 628-0846.

Circle No 641

PC-UNIX LINK

Release 2.0 of Methods permits any IBM PC or compatible personal computer to communicate with any Unix computer via an RS-232C serial port. In addition, the package features an object-oriented programming language, which is a subset of the Smalltalk-80 programming language. To use your PC as a terminal for a Unix-based computer, you open a Smalltalk window on your PC's screen and type in Unix commands. The package saves commands; you can recall commands by scrolling through your command file.

A DOS shell lets you execute DOS commands or programs without exiting from this program. That shell provides a pop-up menu that displays the operating system's commands. When you return to the Unix operating system, the package reloads itself with Unix commands. $250.

Digitalk Inc, 5200 W Century Blvd, Los Angeles, CA 90045. Phone (213) 645-1082.

Circle No 640

PLD DESIGN

This software package automates PLD design. Included in the list of devices that the program can handle are PALs, erasable PLDs, integrated-fuse logic devices, PROMs, and gate arrays. Proprietary optimization algorithms minimize logic for all devices. In addition, you can use the same design file for any device type, including gate arrays.

The PLD design program lets you specify logic in truth tables, state diagrams, or logic equations. After you select the PLD that you plan to

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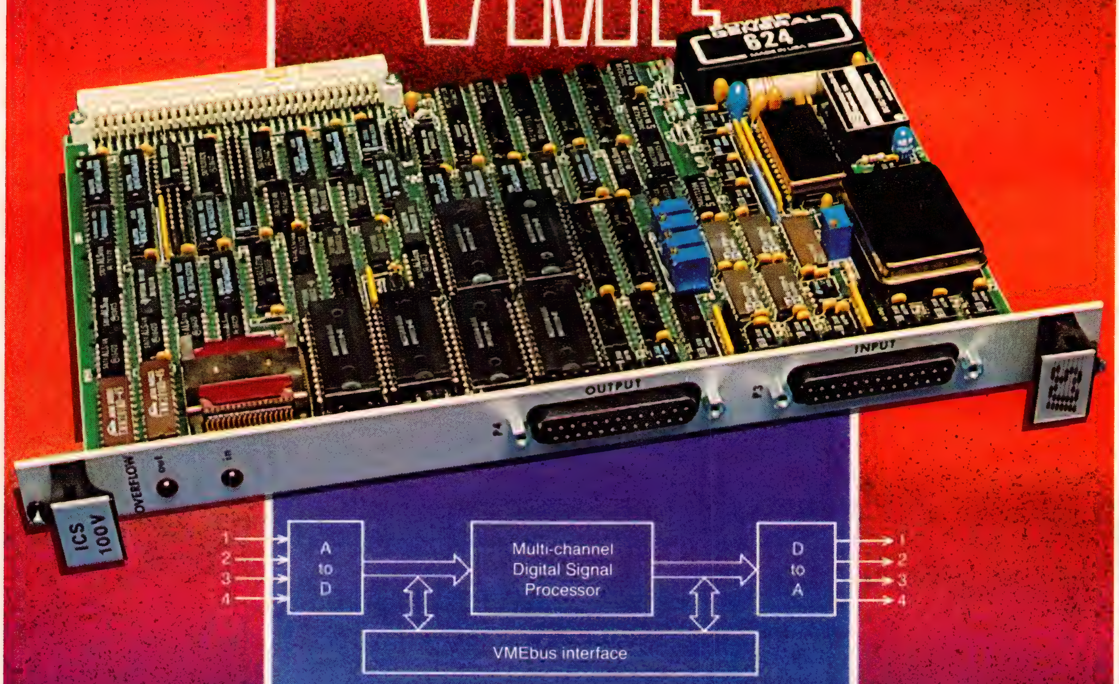

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All four analog input channels are simultaneously sampled at rates of up to 400 KHz and digitized to 12-bit accuracy. Digitized analog data can be directly applied to the filter and is also available in a 512 word FIFO for input to the host. The output DAC's can accept 12-bit data from either the host or the filter output. Optical isolations of both analog sections guarantee uncompromising performances.

100 ns/TAP

The 16-bit digital FIR filter directly handles 4 real or 2 complex input channel data supplied either from the A/D or the host processor with up to 255 taps per channel at a rate of 100 nsec per tap. Following decimation the filter output data is available in a 512 word FIFO for input to the host.

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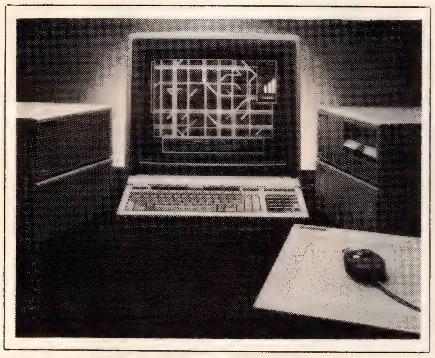
use, the program performs design-rule checks to ensure that you are using the device according to its specifications. Besides designing programmable logic, the package can also generate test vectors.

The package runs on IBM PCs or compatibles, DEC VAX, Apollo, and Prime computers. Depending on the number of modules you purchase, the program costs between $1190 and $6700 in its PC-compatible version; minicomputer versions range from $3400 to $19,700.

Elan Digital Systems, Box 1610, San Anselmo, CA 94960. Phone (408) 734-2226.

Circle No 642



PC-BOARD LAYOUT

The HP Printed Circuit Design System couples pc-board layout with design, manufacturing, and testing. The system runs on HP 9000 Series 300 technical workstations under the HP-UX operating system. The company has licensed the package's source code from Bell Northern Research. (The layout software is the same as Bell Northern's Circuit Board Design System-III.) To enter a net list, you can tranfer data from the company's logic design system or its engineering graphics system, as well as from any system that uses the Electronic Design Interchange Format, to the layout system. The system automatically positions logically connected gates as close together as possible.

The component library provides nearly 4500 digital and analog parts. Parts with common outlines share space in the database. During a route, you can check the progress of automatic routing; the router can use 50-, 25-, and 20-mil grids. A look-ahead algorithm plans routing strategies. When your design is complete, the system generates photoplotter instructions, N/C drill tapes, and production reports. Including hardware, the package costs from $60,000 to $82,000. Delivery, 12 to 16 weeks ARO.

Hewlett-Packard Co, 1820 Embarcadero Rd, Palo Alto, CA 94303. Phone local office.

Circle No 645

SIMULATION MODEL

The Smartmodel behavioral model of the Intel 80386 microprocessor interfaces to logic simulators. It runs on Mentor Graphics' (in both the QuickSim and Cadat logic simulators) and Daisy Systems' CAE workstations. This model enables you to verify pc-board designs that include the 80386 μP. This behavioral model features a series of checks for timing and usage errors. When an error occurs in a design, the software generates an error message pinpointing the cause of the error. For example, the 80386 model can identify unknown values on Hold or Reset pins. $1830.

Logic Automation Inc, Box 310, Beaverton, OR 97075. Phone (503) 690-6900.

Circle No 643

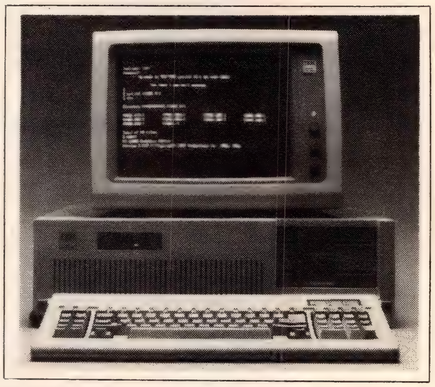
LAN SOFTWARE

Two networking software products, the Case kernel library, and the Netbios kit, are designed for OEM LAN vendors that create factory- or office-automation networks. Using the Case kernel library's set of subroutine functions, you can interface your application programs to a LAN. The kit enables your LAN hardware products to emulate IBM's PC Netbios at the IBM PC's 5C level.

The Netbios kit, which runs on IBM PC/ATs and compatible computers, includes a sample connection to the company's ISO Transport and Internet protocol. The Case kernel library interfaces to the company's ISO Session layer protocol. Both packages provide source and object code. Case kernel library, $3500; Netbios kit, $15,000.

Syros Inc, 1050 E Southern, Suite B-3, Tempe, AZ 85282. Phone (602) 966-2661.

Circle No 644



TERMINAL EMULATOR

The G Term/E Term graphics terminal emulator turns IBM PCs into graphics terminals for VAX/VMS or MicroVAX II computers and gives you desktop control of this company's CAE design package running on those systems. This package uses the PC as a window to the VAX family of computers so that you can create more complex designs than are possible on a PC.

The software transmits drawing files—which require less time to transmit than do net-list files—to the host computer; the VAX or MicroVAX II then compiles, simulates, and stores the design. Multiple users can access the data via PCs under a VMS timesharing system. The package requires standard PC hardware, at least one serial communications port (IBM Async adapter or equivalent), and either a Hercules or an EGA-compatible graphics board. $2500.

Case Technology Inc, 633 Menlo Ave, Menlo Park, CA 94025. Phone (415) 322-4057. TLX 506513.

Circle No 646

LAB SOFTWARE

Designed for data acquisition, test, measurement, and control, the Labtech Notebook generally requires one keystroke for most operations. Programming features let you record and control voltage, current, thermocouple, and digital-input data in real time. The package generates both open- and closed-loop proportional - integral - derivation output.

An iterative algorithm that accepts as many as 10 parameters fits curves to theoretical models. If your PC includes an 8087 or 80287 floating-point coprocessor, you can accelerate the curve-fitting process.

The package runs on IBM PCs and compatible computers; you can interface it to this company's PCI20000, PCI3000, and PCI4301 IBM PC-compatible I/O boards. You can interface this package to spreadsheets like Lotus 1-2-3 and customize your data-analysis procedure. $895.

Burr-Brown Corp, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111. TLX 666491.

Circle No 662

TACTILE INPUT

Instead of writing code, you can produce programs in Lattice C with Touch-Mate that control scanning-infrared touch-input products. A series of subroutines enable the package to determine the communication protocol and touch-to-screen coordinates. Another subroutine debugs communication links. The package includes a target editor, target manager, and a touch library.

The target editor lets you build a database of touch-target definitions. These definitions cover the entire touch-active area; you can superimpose this data over a graphics symbol.

You can use the target manager to manipulate definitions that the target editor creates. The target manager also decides when a touch of the display screen falls within a currently active target area.

The touch library handles data communications. This subroutine also converts touch-system coordinates to the coordinates of your display.

Touch-Mate runs on IBM PCs and compatibles. The package costs $400 for development software and $1000 for a run-time version.

Carroll Touch Inc, Box 1309, Round Rock, TX 78680. Phone (512) 244-3500. TLX 881906.

Circle No 664

NETWORK SOFTWARE

Two software products, Exos 8052-01 Netbios TCP/IP and Exos 8051-02 TCP/IP, enable personal computers to communicate concurrently with other personal computers and with dissimilar host computers. The packages run on the Ethernet TCP/IP protocol.

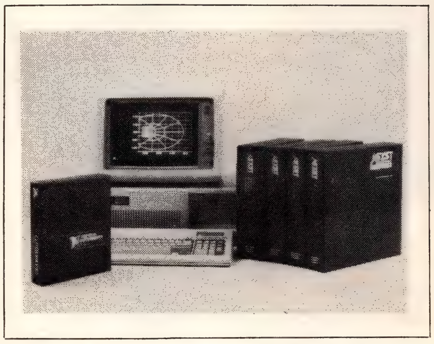
The Exos 8052-01 Netbios package provides compatibility with IBM's Netbios interface standard. The Netbios interface lets you run any PC/DOS 3.1 application program across an Ethernet network, if the program is compatible with Netbios.

The Exos 8051-02 program features a socket library, which lets you write code to interface personal computers to host computers that use the TCP/IP protocol. The socket library uses the Unix 4.2 BSD socket-interface standard. You can use this package to communicate with Unix-based systems such as DEC, VAX, Sun Microsystems, NCR, Sperry, and IBM host computers. The program includes file-transfer and terminal-emulation software.

Both packages run on this company's Exos 205 Ethernet controller board. Exos 8052-01 Netbios, $95; Exos 8051-02, $595.

Excelan Inc, 2180 Fortune Dr, San Jose, CA 95131. Phone (408) 434-2300. TLX 176610.

Circle No 665



ANALYSIS PACKAGE

Systems that use the GPIB (IEEE-488) interface can run this version of Macmillan Software's Asyst package. Asyst targets scientific applications—the program features least-squares approximation, convolution, integration, smoothing, and fast-Fourier transforms. To display results, the program generates line graphs, scatter plots, and pie charts.

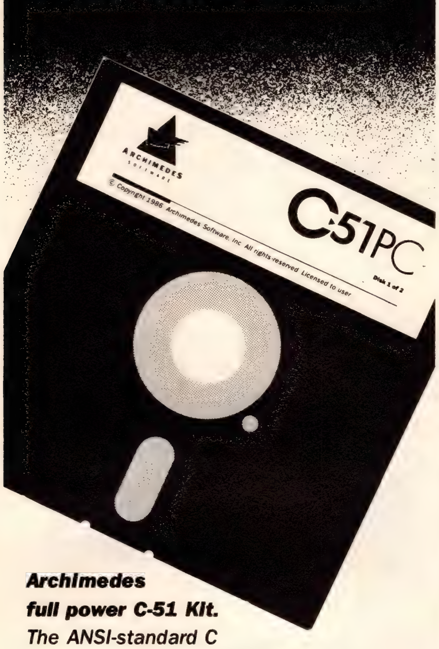
Asyst runs on IBM PCs and compatible personal computers. Because this package can communicate with the GPIB parallel interface, you can collect data with instruments that use this interface bus and analyze the data on your personal computer.

The GPIB version of Asyst is available either as a complete program or as an add-on to an existing version of the program. Asyst with GPIB, $1995; with GPIB-PCIIA, $2290. As an add-on, $495; with GPIB-PCIIA, $695.

National Instruments, 12109 Technology Blvd, Austin, TX 78727. Phone (800) 531-4742; in TX, (800) 433-3488. TLX 756737.

Circle No 667

The 8051 Time-Saver.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C51PC
Disk 1 of 2

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The ANSI-standard C for Intel 8051 microcontrollers.

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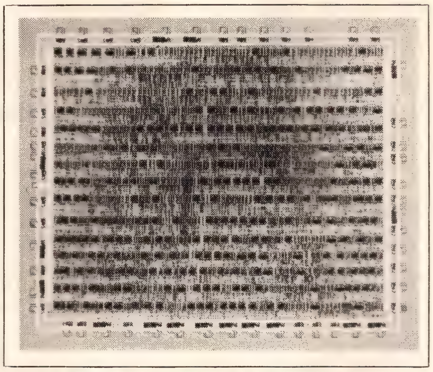
CIRCLE NO 83

Software



STANDARD-CELL CAD

This kit enables you to lay out standard-cell ICs for the MOSIS (MOS implementation system) project at the University of Southern California Information Sciences Institute. The kit implements a 3-μm process technology.

Because the kit couples the MOSIS standard-cell library and the cells' schematics, its designs are correct by construction. According to the manufacturer, the package can generate a layout in several hours. To obtain a chip, you mail a pattern-generation tape to the MOSIS project. The MOSIS kit costs $400; prototype standard-cell ICs range in price from $3500 to $10,400.

Mentor Graphics Corp, 8500 SW Creekside Pl, Beaverton, OR 97005. Phone (503) 626-7000.

Circle No 647

DEBUGGING TOOL

You can use Softprobe II to detect errors in high-level-language μP programs. This interactive source-level debugging tool specializes in embedded system applications for Intel iAPX-86 microprocessors. It can report the identities, types, and variables (both local and global) that you have defined in your μP program. Variable declaration and reference, expression evaluation, read and write, procedure call to user program, high-level flow command, and program patches are all available in the debugger.

To help you develop real-time embedded systems, the debugging tool includes breakpoint and single-step execution controls. A file traces program flow and profiles operations. The program supports mixed-language program development in C, PL/M, Pascal, and ASM-86. The package runs on VAX and MicroVAX computers, as well as IBM PCs that include a 32-bit coprocessor board and Unix-based workstations. From $6750.

Systems & Software Inc, 3303 Harbor Blvd, Suite C-11, Costa Mesa, CA 92626. Phone (714) 241-8650. TWX 910-695-0125.

Circle No 648

LOGIC SIMULATOR

In addition to simulating logic, Insight lets you manipulate signals interactively while you model your digital circuit. Interactive features include breakpoints and a single-step time probe. You can change test vectors as you run the program and thus improve error detection.

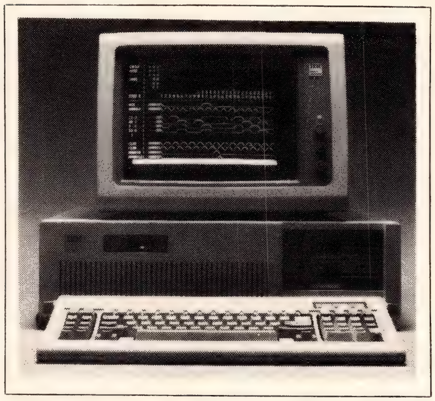
The program accepts net lists, state-machine diagrams, Boolean equations, and combinations of equations and net lists. If your design includes PLDs, you can enter a transition diagram for a state machine and PLD equations separately, and the program will verify that the equations agree with the state machine. The package runs on IBM PCs and compatible systems and on all VAX computers. For IBM PCs, the package costs $5000; for VAX system, prices vary from $15,000 to $70,000, depending on CPU.

Intellisys Inc, 510 Lawrence Expressway, Suite 210, Sunnyvale, CA 94086. Phone (408) 720-0733.

Circle No 651

LOGIC SIMULATOR

An identical version of the Cadat logic and fault simulator runs on the IBM PC, PC/XT, PC/AT, MicroVAX, and VAX computers. These systems all use the same command set. The simulator package features switch, gate, and behavior-

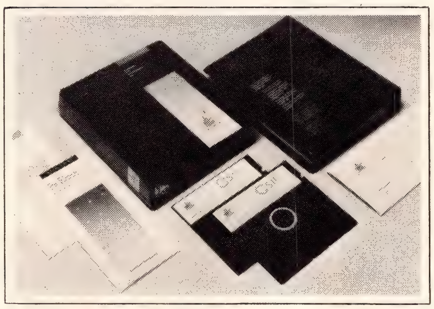


al modeling. Furthermore, it includes concurrent fault simulation and timing analysis with 21-state switch-level simulation.

The simulator can compensate for circuit-loading effects and resolve reconvergent fan-out problems and MOS bus contentions. You can display the simulator's output graphically or digitally. The vendor also offers a hardware modeler, which you can interface to multiple workstations through a LAN. The simulator's library includes over 2000 SSI/MSI models. PC/AT version, $4250.

Case Technology Inc, 633 Menlo Ave, Suite 250, Menlo Park, CA 94025. Phone (415) 322-4057.

Circle No 649



C COMPILER

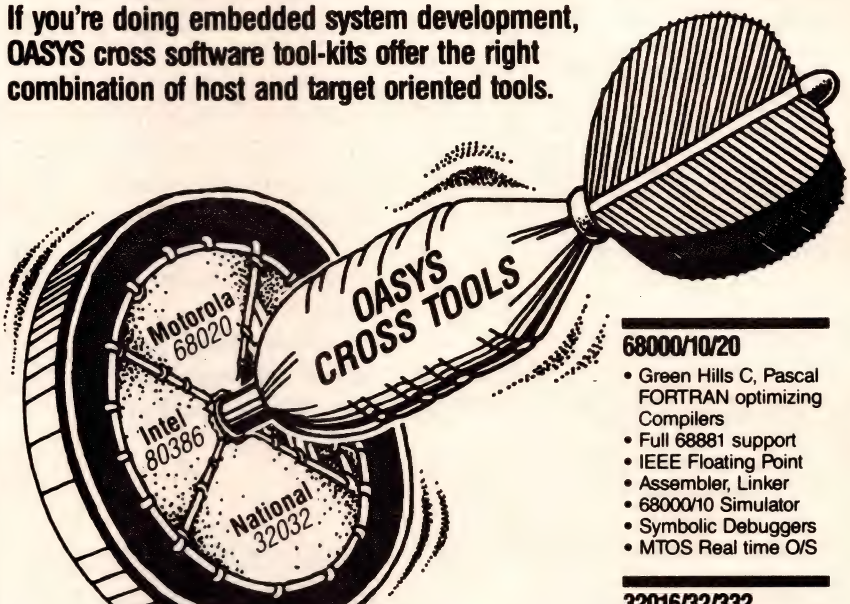
By using the C-51 Cross-Compiler Kit, you can program members of the 8-bit 8051 microcontroller family in C. The kit includes a C compiler, a library of functions, a macroassembler, a linker, and a librarian.

Because several memory models are available, you can optimize the microcontroller design that you select. The compiler uses the IEEE standard for 32-bit single-precision floating-point arithmetic. Other features include program listings and assembler-code generation.

Output formats such as Intel hex enable the software to communicate with most PROM programmers and emulators. The emulator utility provides symbolic debugging for a variety of emulators. The C-51 kit runs on IBM PCs and compatible computers that contain 512k bytes of RAM and run MS-DOS 2.1 or later versions. VAX-compatible versions are also available. $995 for the PC version; $3995 for a package that runs on a VAX.

Archimedes Software Inc, 1728 Union St, San Francisco, CA 94123. Phone (415) 771-3303.

Circle No 657



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Software

FAILURE PREDICTOR

Operating on an IBM PC, PC/XT, or PC/AT, PC-Predictor can project the reliability (MTBF), safety, and maintenance needs of a design at any stage of system development. To predict component failures, the package relies on a library of the Electronic Industry Standards for Prediction of Failure Rates and on MIL-HDBK-217 standards. In addition to predicting failures, the package analyzes the effect on a system of component failures. The library represents 40,000 components. $5500.

Control Data Corp, ECAD Marketing, HQW05H, Box 0, Minneapolis, MN 55440. Phone (612) 853-8100.

Circle No 650

TEST GENERATOR

Testpla automatically generates test vectors for PLD designs. To develop a set of test vectors, the package analyzes a JEDEC fuse pattern and generates the minimum set of stimulus vectors that test every unblown product junction for stuck-at-zero faults and every unblown fuse for struck-at-one faults.

After minimizing the set of stimulus vectors, the program performs a state-machine analysis of the test pattern and generates a graph of transitions of the state. This graph enables you to develop test vectors for registered PLDs that lack a preload feature. The program appends its test-vector set to your JEDEC fuse pattern; you can transmit the test vectors directly to your PLD programmer. The package, which runs on IBM PCs and VAXs, costs $895.

Structured Design Inc, 1700 Wyatt Dr, Suite 7, Santa Clara, CA 95054. Phone (408) 988-0725. TLX 172931.

Circle No 653

IC-DESIGN LIBRARIAN

Icebox aids users of Autodesk's AutoCAD package in the designing and shaping of integrated circuits. Running independently of AutoCAD, the package contains an editor that can create and edit IC shapes. The drawing editor can define commonly used symbols such as ground, capacitors, and transistors. $295, including one library; $50 for each additional library.

International Microsystems Inc, 11554 C Ave, Auburn, CA 95603. Phone (800) 325-6028; in CA, (916) 885-7262.

Circle No 654

PC-BOARD CAD

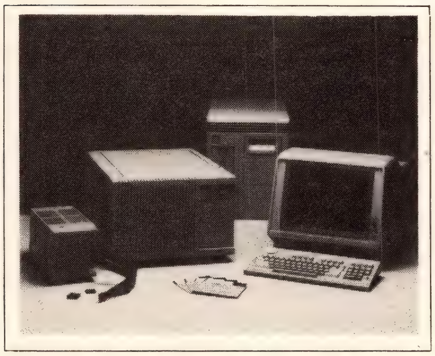
Quik Circuit is a pc-board CAD system that includes Apple's Macintosh computer. The system lets you use a mouse to enter and edit pc-board layouts. You can check your artwork by printing it either in black and white on Apple's Imagewriter printer or in color on an optional pen plotter.

Features in this version of the CAD package include surface-mount technology and a library of shapes for circuit traces and pads. Boards can be as large as 32×32 in^2; grids can range in size from 0.001 to

1 in. After you have created your design database, your pc-board manufacturer can use the database to produce a photoplot of the layout. The manufacturer can also use the database to generate N/C instructions for drilling holes in the board. CAD package, $4300; software only, $695; pen plotter, from $1315.

Bishop Graphics Inc, Box 5007, Westlake Village, CA 91359. Phone (818) 991-2600. TLX 662400.

Circle No 652



µP-SUPPORT SYSTEM

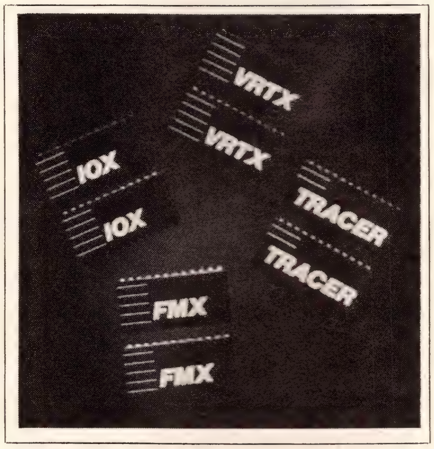
In addition to software-development tools for 32-bit µP-based systems, Multi-V systems provide instruments that enable you to integrate software and hardware. The software-development tools consist of language support (in C) for Motorola's 68020 and Intel's 80286 microprocessors. A 68020 emulator and an 80286 emulator make up the hardware-integration system.

The C program-development package (Clands II) includes a C compiler, C language editor, 32-bit macroassembler, reloading linker, a system that integrates program segments, and a debugger. You can transfer output from the compiler or the assembler from your host computer to this package's software executor, which contains the 68020 and the 68881 floating-point coprocessor (or the 80286 and the 80287 coprocessor). The debugger then verifies your software.

Multi-V Systems run on all members of the DEC VAX family. In addition, you can interface the software to the VAX's LAN; users can also communicate with the package via an RS-232C interface. Systems start at $20,000. Availability, eight weeks ARO.

Tektronix Inc, Box 14752, Portland, OR 97214. Phone (800) 342-5548; in OR, (503) 629-1573.

Circle No 655



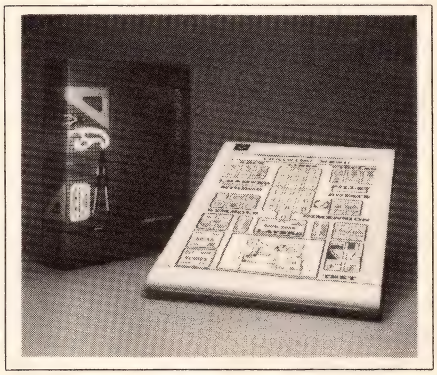
OS FOR VME

The MVME device-support packages allow users of three VME module units—the MC68010-based MVME117 and MC68020-based MVME130 single-board microcomputers and the MVME320 Winchester/floppy disk-drive controller—to interface the boards' hardware devices to the VRTX operating system.

Because each MVME device-support package includes a source-code listing, you can modify variables, such as baud rate, to fit specific applications. The MVME117 and MVME130 packages provide driver support for onboard devices like the MC68881 floating-point coprocessor, RS-232C ports, 8-bit parallel ports, the SCSI bus, the MC68B40 programmable timer, and the 8-bit software-readable front-panel switch. MVME117 and MVME130 device-support packages, $500 each; MVME320 package, $1000.

Hunter & Ready, 449 Sherman Ave, Palo Alto, CA 94306. Phone (800) 228-1249; in TX, (214) 661-9526. TLX 278835.

Circle No 658



DRAFTING PACKAGE

A computer-aided drafting package, FastCad displays bit-map images of data in a vector database. In addition to a zoom capability, the program features screen redraws from 16 views. The package includes a 300-key digitizing tablet that offers predefined menu overlays and symbol management. After you record a keystroke sequence in the tablet, you can repeat the sequence with one keystroke.

When using this package, you can save as many as 256 registered overlapping layers and create a floating-point database structure. The drawing catalog manages filenames with as many as 25 characters. The drafting package can run on IBM PCs that contain any of 21 graphics-controller cards. (Screen resolution as great as 1024×1024 pixels is available.) A software module supports most pen plotters and graphics-input devices that interface to IBM PCs. $595.

Zericon, 655 John Muir Dr, Suite 416, San Francisco, CA 94132. Phone (415) 239-0112.

Circle No 656

VENIX SUBSET

JV Venix is a subset of the full System V implementation and includes utilities for most nondevelopment Unix tasks. It is available for the IBM PC/AT, PC/XT, and compatibles.

This subset of Venix includes the kernel, all standard peripheral I/O drivers, approximately 100 commands and utilities, and the 2-user

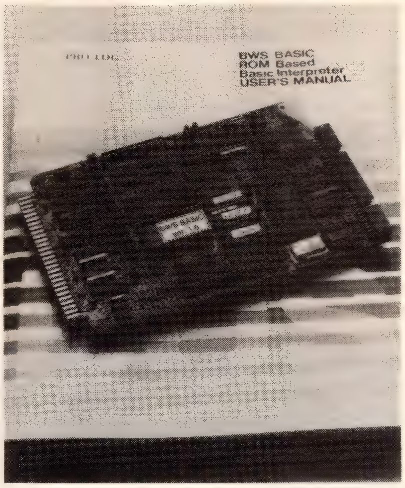
AT&T license. Besides 38 standard primary commands such as cp (copy) and cat, utilities such as awk, find, sort, and grep are included as well as the Bourne and C shells.

When you need to expand into program development, graphics, or networking, add-on modules are also available. $395 for the operating system; add-on modules from $99 to $495.

Unisource Software Corp, 23 East St, Cambridge, MA 02141. Phone (617) 577-8383.

Circle No 660

BASIC MODULE



BWS Basic is a multitasking Basic interpreter that runs on this company's 7806 Z80-based CPU card for the STD Bus. The interpreter handles standard Basic commands and contains features that allow you, in real time, to create and execute a Basic program that controls and monitors as many as 16 tasks simultaneously. The interpreter checks timing and I/O-port values before executing a task. The Auto command provides automatic execution of a program when the power comes on or when the system is reset.

Access to the real-time clock eliminates the need to generate software timing routines. The 7806 card features a Z80 processor, two RS-232C ports with cable, and four memory sockets—two for system use and two for application RAM or ROM. You can connect the subsystem to a host computer via the serial ports and cable. Once you create a program, you can execute it on the STD Bus target system or download it to a PROM programmer. Software, $150; card, $340.

Pro-Log Corp, 2411 Garden Rd, Monterey, CA 93940. Phone (408) 372-4593. TWX 910-360-7082.

Circle No 659

PROGRAM ASSEMBLER

Although the Avmac assembler's transparent buffering scheme provides the speed of memory-based assembly, the buffer doesn't restrict your file size. The Avmac assembler produces relocatable object, listing, and cross-reference files.

Besides the assembler, the pack-

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The I.C.E.BOX is available for the Z80, 8085, and NSC800 processors for $600.00. The REFRIGERATOR (Z80 only) is $900.00. Contact Softaid, Inc., 8930 Route 108, Columbia, MD 21045 — (301) 964-8455. We accept Visa, Mastercard, checks and COD.

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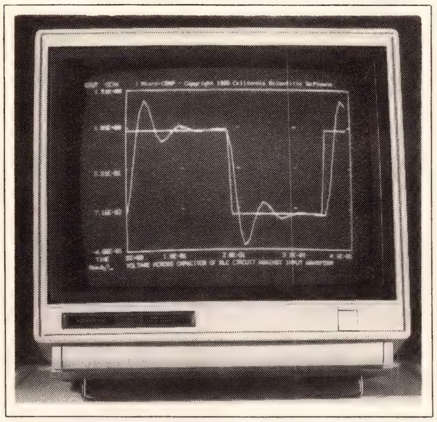
age includes a macro preprocessor, cross-reference generator, linker, and object librarian. The cross-reference generator produces cross-reference and symbol-table reports for relocatable segments, public symbols, and module-specific symbols. The linker generates absolute object files, symbol tables, and link maps. The object librarian combines relocatable modules into searchable libraries and extracts modules from libraries.

Two utility programs, Libdir, and Hexform, respectively display the contents of your library and convert hex object files to binary code. Avmac runs on IBM PCs under MS-DOS and PC-DOS; the package also runs on VAXs under Unix and VMS. The PC-based package costs $349; VAX-compatible software costs $995 for the Unix version and $1195 for the VMS version.

Avocet Systems Inc, Box 490 Rockport, ME 04856. Phone (800) 448-8500 or (207) 236-9055. TLX 467210.

Circle No 661



LINEAR ANALYSIS

LSAP (linear-systems analysis package) uses IBM PCs and compatible personal computers to analyze linear circuits. The program produces phase-change and group-delay plots that can check your design's stability. Root-locus diagrams can help you establish the stability margin that your design requires. A transient-response plot verifies circuit response.

The package can handle linear systems that contain as many as 45 zeros and 45 poles. You can view program results as printer plots. If your PC includes a graphics adapter, you can generate on-screen plots; either an Epson or an IBM printer can print the on-screen plots.

LSAP runs on all MS/DOS and PC/DOS computers that contain at least 256k bytes of memory. Although the package can run without a floating-point coprocessor, you can use an 8087 or an 80287 to accelerate your linear analyses. $450.

California Scientific Software, 25642 Hazelnut Lane, El Toro, CA 92630. Phone (714) 581-7654.

Circle No 663

$975

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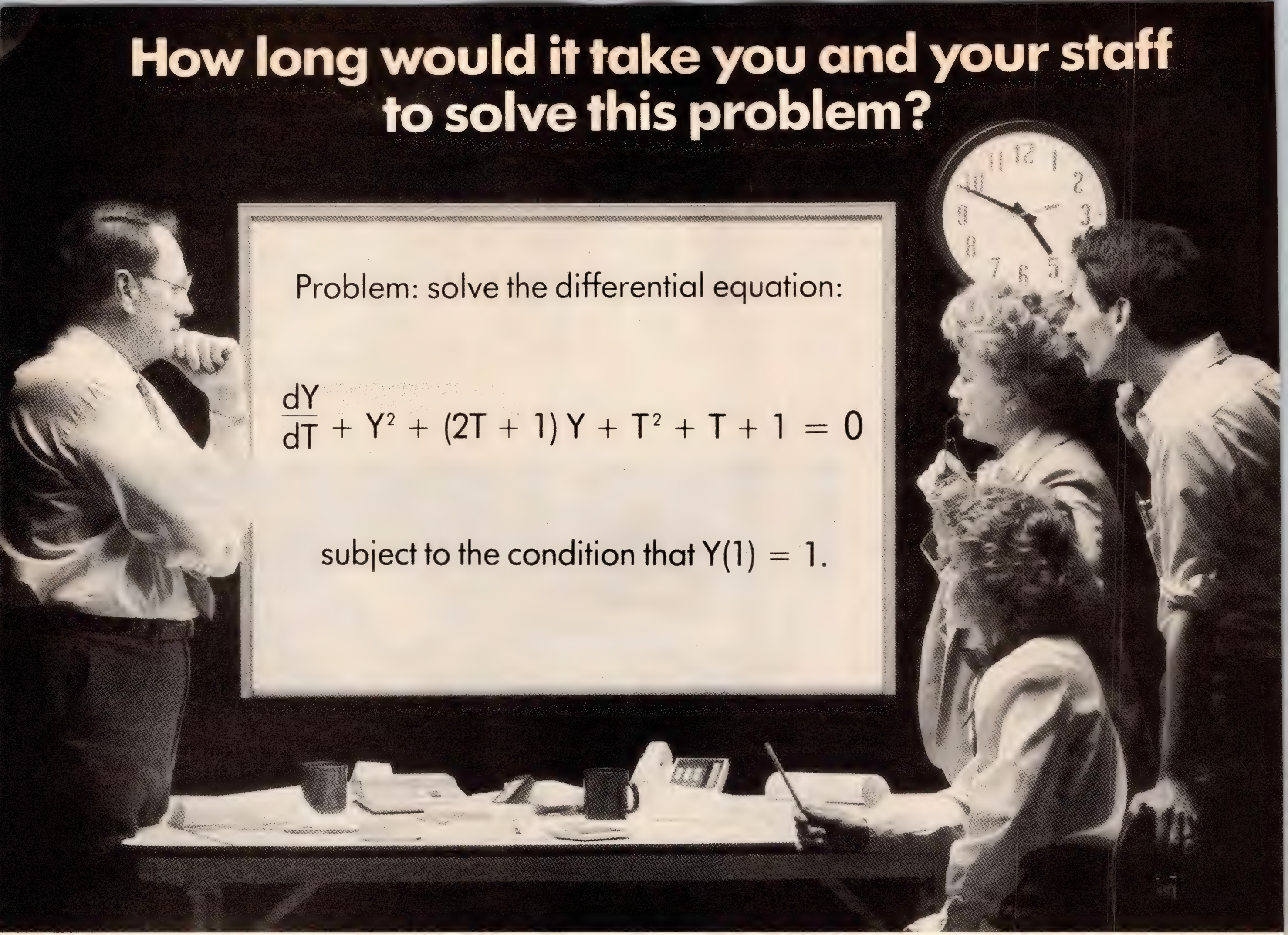
CIRCLE NO 6

How long would it take you and your staff to solve this problem?



Problem: solve the differential equation:

$$\frac{dY}{dT} + Y^2 + (2T + 1)Y + T^2 + T + 1 = 0$$

subject to the condition that $Y(1) = 1$.

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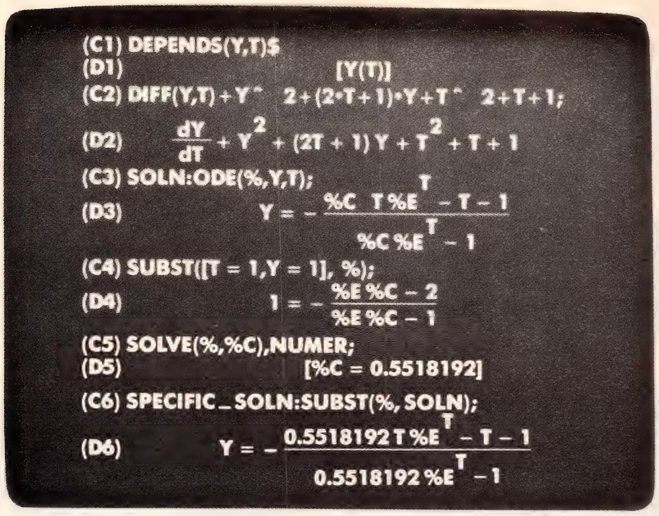
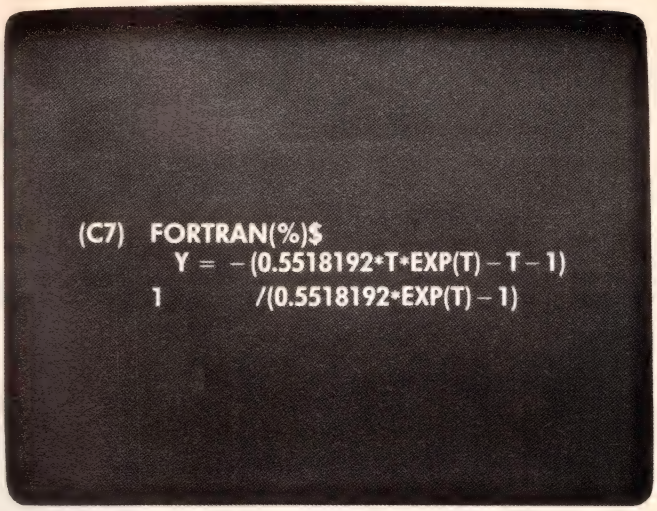


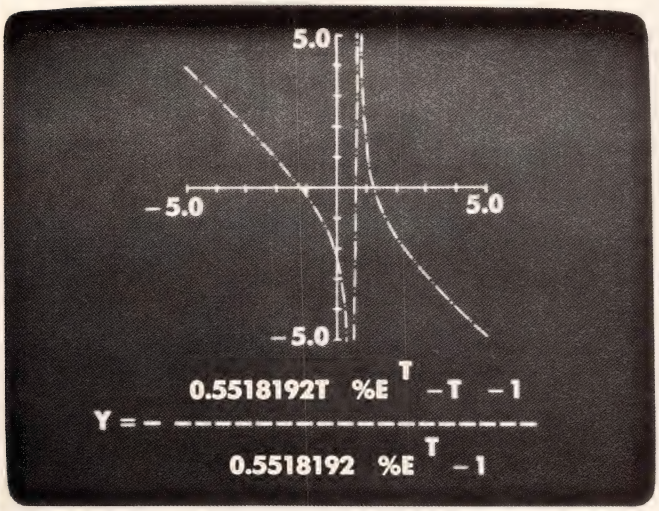
```
(C1) DEPENDS(Y,T)$
(D1)                        [Y(T)]
(C2) DIFF(Y,T)+Y^ 2+(2*T+1)*Y+T^ 2+T+1;
               2                2
(D2)      dY + Y  + (2T + 1) Y + T  + T + 1
          --
          dT
(C3) SOLN:ODE(%,Y,T);
                                  T
(D3)                 %C  T %E   - T - 1
                Y = - -----------------
                                 T
                          %C %E   - 1
(C4) SUBST([T = 1,Y = 1], %);
                      %E %C - 2
(D4)              1 = - ---------
                      %E %C - 1
(C5) SOLVE(%,%C),NUMER;
(D5)                    [%C = 0.5518192]
(C6) SPECIFIC_SOLN:SUBST(%, SOLN);
                                     T
(D6)              0.5518192 T %E  - T - 1
             Y = - ----------------------
                                   T
                     0.5518192 %E   - 1
```

In symbolic form.



```
(C7)   FORTRAN(%)$
          Y = - (0.5518192*T*EXP(T) - T - 1)
       1          /(0.5518192*EXP(T) - 1)
```

In FORTRAN code.



```
                              T
         0.5518192T   %E    -T   -1
Y = -  ------------------------------
                              T
           0.5518192   %E    -1
```

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Lab/benchtop power offer a wide range of

J D Mosley, *Regional Editor*

Although programmable lab and bench power supplies have been available for years, this year more manufacturers are incorporating a greater variety of features in their power supplies. Power-supply models now come with such features as built-in GPIB interfaces, onboard ROM and RAM, LED voltage and current displays, programmable error detection, automatic self-testing, and multiple outputs. The supplies also offer an increasingly wide range of voltages and currents. Of course, although these extra features can boost your productivity, they can also boost your power supply's price, so before you choose a supply, consider which extra features you really need. For instance, if you want to have a computer control or monitor your supply's voltage output, or if you need a wide range of output voltages, you'd do well to choose a supply with a built-in GPIB programming interface. But if you're not going to need computer remote control or a wide output-voltage range, you won't want to pay extra for a GPIB interface. Instead, you'll probably prefer to buy a low-cost supply that offers only front-panel voltage and current control.

One of your first considerations when choosing a power supply will be which programming method you'll use. Until recently, you could

***Programmable 4-output regulated power supplies** (Hewlett-Packard Co)*

supplies functions

This year's programmable lab and benchtop dc power supplies offer more features than ever before. Designers who don't require such extras as multiple outputs or a GPIB interface, however, can still choose from a variety of less-expensive models that provide only basic features and offer extra features as options.

use only two methods: You could control the supply's output voltage and current by putting a resistor of a particular size across terminals located on the back of the supply, or you could buy a GPIB-interface module, which would translate specific digital instructions from your computer or terminal into control signals for the supply. The module could add $800 or more to the cost of your power-supply system.

Many power supplies now have built-in GPIB interfaces, however. In addition to the interfaces, some supplies also provide front-panel voltage and current control. Two manufacturers even put digital keypads on their supplies, so you don't need an external computer to program the units.

Keypads give you direct control

Each supply in the Hewlett-Packard 6620A Series, for example, offers three separate keypads on the front panel for programming control. The unit provides multiple outputs, 16 built-in programmable functions, and a multifunction LCD that monitors every operation. Models 6621A and 6622A are dual-output 80W supplies. Model 6623A has three outputs, and Model 6624A provides four outputs.

Each model includes a GPIB in-

To provide computer control of your supply's output or to obtain a wide range of output voltages, choose a supply with a built-in GPIB programming interface.

2-kW power supply *(Power Ten Inc)*

terface with which you can program a number of functions, such as voltage and current settings; output-channel enable/disable; unit identification; overvoltage protection; overcurrent-protection enable/disable; present and accumulated status readback; delay time for service-request mask; error-code readback; storage and recall of programmed value sets; reset of trip conditions for overvoltage and overcurrent; self-test execution; front-panel message display and enable/disable; and software calibration.

You can program all but the last four commands from the keypads located on the front panels of these units. You can program all the commands by plugging your computer or terminal into the GPIB connector located on the rear panel of the power supply and transmitting GPIB programming commands to the supply. CIIL (Control Interface Intermediate Language) programming capability is available as an option.

The 6620A Series also offers an assortment of protection features. The local-lockout feature lets you disable all the front-panel controls except Channel Select. Current limiting, however, remains active at all times, preventing overcurrent conditions. You can enable a second current-protection feature that will shut down the supply in the event that the current-limiting feature fails to contain the output current. The supplies also provide protection against overvoltage conditions, thermal overload, and line-voltage dropout.

You can calibrate a 6620A Series supply without removing its cover. You need only a digital voltmeter, a shunt, a controller, and a few lines of code. The supplies, which cost from $2700 to $3700, provide remote-sensing capability, programmed minimum current, current sourcing and sinking, reactive-load stability, and series or parallel output capacity.

Also programmable via front-panel keypads are the members of Quality Power Systems' PD 7000 Series, which includes five 60W models. The keypads let you control all programming functions. GPIB, RS-232C, and binary interfaces are available as options.

The PD 7000 units automatically perform a series of self tests when you turn them on. You can set the voltage and current for either output independently by pressing the appropriate keys, by calling preset values from the unit's ROM or RAM, or by downloading instructions from a remote computer or controller. One

Zero to 325V, 0 to 0.8A programmable supply *(Kepco Inc)*

keystroke lets you specify high or low ripple, provide master/slave tracking between outputs, or redefine output margins.

Each model features two LEDs for monitoring output and displaying error messages. Each offers remote sensing and corrects for as much as 0.5V drop per lead. The supplies all offer continuous overload protection. They cost $1995; the interface boards sell for $295.

You can also find supplies without built-in programming interfaces. Sorensen Co, for instance, offers optional programming modules that can control a variety of supplies. Sorensen's μP-controlled D/A programmer module, the 488 Micro DAP, can govern as many as two programmable power supplies at once. You can put four of the programmers into a single 19-in. rack chassis.

The 488 Micro DAP provides both talker and listener functions. In its talker mode, the DAP translates digital CIIL commands from a remote computer or terminal into an analog output voltage that causes the power supply to produce the requested output, from 0 to 600V. Thus the DAP acts as a miniature power supply which evokes a larger output from the controlled power supply. The DAP also accepts commands in Sorensen's proprietary, simplified version of CIIL. The commands set voltage and current; report limit overload, overvoltage trip, and thermal shutdown; give a menu of all programmed values; trigger an alarm condition and a recorder; signal ac power disconnection; connect and disconnect power load; and signal output polarity.

In its listener mode, the DAP monitors the power supply's response to its commands and sends a status report to the host computer or terminal. Its error messages include syntax-error messages, value-error messages, output-setting reports, status reports, and alarm status. The talker/listener exchange offloads virtually all of the power-supply monitoring and control functions. A single-channel DAP is priced at $790, while a 2-channel DAP costs $1050.

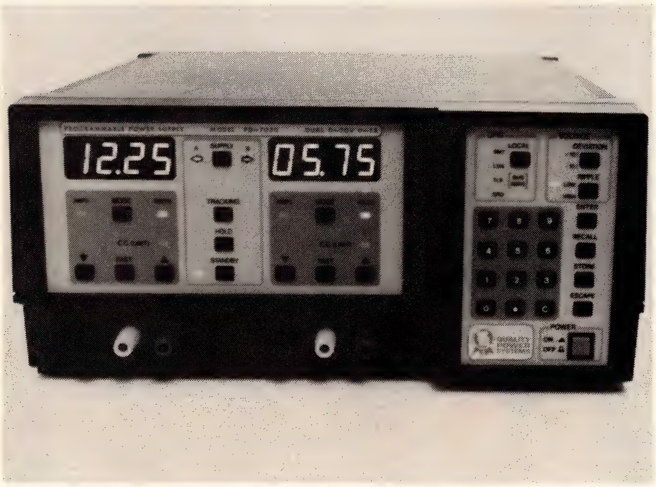
Four-voltage-range power supply *(Kikusui International Corp)*

You can also use the DAP to control the supplies in Sorensen's compact 60W XT series. These units measure 5.2×4.3×11.7 in. and provide LED numbers and bar graphs that let you monitor output and transient changes. Built-in impedance-switched remote-sensing terminals compensate for load/output fluctuations. The series comprises six models, which offer voltages ranging from 0 to 120V and current ranging from 0 to 6A. Each supply costs $490. If you wish, you can have the supplies packaged for multiple outputs.

For single-phase power levels ranging from 400 to 2700W, the members of Sorensen's DCR-B Series provide 0 to 600V outputs. You can connect the DCR-B supplies in parallel or in series for a maximum output of 200V. Each unit offers remote shutdown, overvoltage protection, and a fan. Each supply comes in a benchtop-size package; prices range from $985 to $2075.

The latest of the company's supplies to support

For applications that require high voltages, you can use a series of supplies that offer output voltages to 75 kV and output currents to 225A.



***Programmable dual-output power supply** (Quality Power Systems)*

control by the DAP is the 3-phase, 10-kW DCR-T Series. Housed in a 19×24×12¼-in. case and priced at $3900, the series offers nine models with outputs ranging from 0 to 600V and 16 to 900A. The DCR-T has separate remote programming and remote sensing circuits, which prevent the possibility of voltage breakdown across output components. The supply also features EMI ac-line protection and remote readout of all meters and indicators.

Programmer controls multiple outputs

If you require a supply that's compatible with the IBM PC, consider using Lambda's GPIB-programmable module, the Programmable IEEE-488 Power System, which acts as an interface between your computer and as many as six power-supply outputs. You can order a single rack-mountable unit with slot-size power sup-

REPRESENTATIVE PROGRAMMABLE DC POWER SUPPLIES

						CONSTANT-VOLTAGE MODE		
MANUFACTURER	MODEL	OUTPUT VOLTAGE	OUTPUT CURRENT	OUTPUT POWER	TRANSIENT RESPONSE	RIPPLE AND NOISE	TEMPERATURE COEFFICIENT	SOURCE REGULATION
BERTAN	210-30	0 TO 30 kV	0 TO 4.5A	N/A	N/A	1.5V P-P	50 PPM/°C	0.001%
ELECTRONIC MEASUREMENTS	HCR300-0.9	0 TO 300V	0 TO 0.9A	250W	50 mSEC	500 mV RMS	0.02%/°C	0.1% V_{MAX}
	ATR-100	0 TO 32V	0 TO 10A	100W	50 µSEC	1 mV RMS	0.02%+400 µV/°C	0.01%+2 mV
HEWLETT-PACKARD	6621A	0 TO 20V	0 TO 10A	160W	<75 µSEC	<500 µV RMS	60 PPM+0.4 mV/°C	0.01%+1 mV
	6622A	0 TO 50V	0 TO 4A	160W	<75 µSEC	<500 µV RMS	60 PPM+1 mV/°C	0.01%+1 mV
	6623A	0 TO 50V	0 TO 10A	160W	<75 µSEC	<500 µV RMS	60 PPM+0.4 mV/°C	0.01%+1 mV
	6624A	0 TO 50V	0 TO 5A	160W	<75 µSEC	<500 µV RMS	60 PPM+1 mv/°C	0.01%+1 mV
KEPCO	ATE 150-0.3M	0 TO 150V	0 TO 0.3A	50W	75 µSEC	0.3 mV RMS*	0.01%/°C	0.001%
	ATE 325-0.8M	0 TO 325V	0 TO 0.8A	250W	150 µSEC	0.3 mV RMS*	0.01%/°C	0.001%
	ATE 150-3.5M	0 TO 150V	0 TO 3.5A	500W	75 µSEC	0.3 mV RMS*	0.01%/°C	0.001%
	ATE 150-7M	0 TO 150V	0 TO 7A	1000W	75 µSEC	0.3 mV RMS*	0.01%/°C	0.001%
KIKUSUI	PAR 80A	0 TO 80V	0 TO 10A	80W	50 µSEC	300 µV RMS	50 PPM/°C	2 mV
	PAR 160A	0 TO 80V	0 TO 10A	160W	50 µSEC	300 µV RMS	50 PPM/°C	2 mV
LAMBDA	LT-802	0 TO 18V	0 TO 70A	<1.5 kW	N/A	10 mV RMS	0.02%+50 µV/°C	0.02%+2 mV
	LT-824	0 TO 60V	0 TO 50A	<3 kW	N/A	15 mV RMS	0.02%+50 µV/°C	0.02%+2 mV
POWER TEN	2000	0 TO 40V	0 TO 0.6A	24W	N/A	200 µV/1 mV	N/A	0.01%+4 mV
	4050	0 TO 40V	0 TO 50A	<2 kW	N/A	1 mV/5 mV	0.01%+200 µV/°C	0.01%+200 µV
QUALITY	PD 7015	0 TO 15V	0 TO 4A	200W	<900 µSEC	<300 µV RMS	0.009%+1 mV/°C	0.005%+1 mV
	PD 7040	0 TO 40V	0 TO 1A	200W	<900 µSEC	<300 µV RMS	0.009%+1 mV/°C	0.005%+1 mV
	PD 7150	0 TO 150V	0 TO 0.25A	200W	<900 µSEC	<300 µV RMS	0.009%+1 mV/°C	0.005%+1 mV
SORENSEN	XT 7-6	0 TO 7V	0 TO 6A	60W	100 µSEC	1 mV RMS	1 mV/°C	0.02%+4 mV
	XT 30-2	0 TO 30V	0 TO 2A	60W	100 µSEC	1 mV RMS	4.5 mV/°C	0.02%+4 mV
	XT 120-0.5	0 TO 120V	0 TO 0.5A	60W	100 µSEC	1 mV RMS	18 mV/°C	0.02%+4 mV
	DCR 7-300B	0 TO 7V	0 TO 300A	2 kW	100 mSEC	65 mV RMS	1.1 mV/°C	<5 mV
	DCR 60-45B	0 TO 60V	0 TO 45A	2 kW	50 mSEC	125 mV RMS	9 mV/°C	<10 mV
	DCR 600-4.5B	0 TO 600V	0 TO 4.5A	2 kW	50 mSEC	1.2V RMS	90 mV/°C	<75 mV

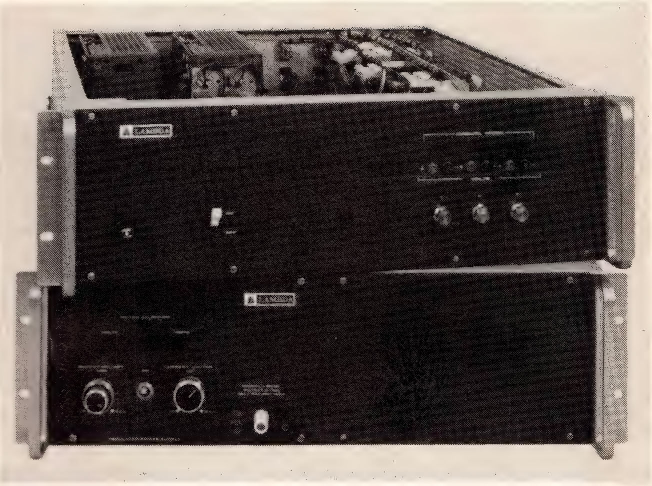
* SPEC DEPENDS ON OPERATING MODE.
** WITH EXTERNAL DIGITAL INTERFACE

NOTES:
A=ONBOARD ROM
B=ONBOARD BATTERY-BACKED RAM
C=LED VOLTAGE AND CURRENT DISPLAYS
D=MULTIPLE PROGRAMMABLE OUTPUTS
E=PROGRAMMABLE ERROR DETECTION
F=OVERCURRENT PROTECTION
G=PROGRAMMABLE OVERVOLTAGE PROTECTION
H=CIIL PROGRAMMING
I=PARALLEL/SERIES OPERATION

plies installed, or you can use the unit to control external supplies.

Each system contains an IEEE interface card and programming cards for each power-supply output. The optional Confidence Check card lets you verify that your power supply's outputs are equal to the values requested by the program. Prices for the system vary according to the configuration you choose.

You could use the Power System, for example, to control one of the company's LT Series 3-kW power supplies. These discrete units cost from $1773 to $3046, and include such features as a soft-start circuit to limit initial current when you turn the unit on, built-in overvoltage protection, remote sensing, and fan-cooling. They come with a 5-year guarantee for operation at 85°C. The eight LT Series models have output voltages as great as 60V and currents as high as 300A.

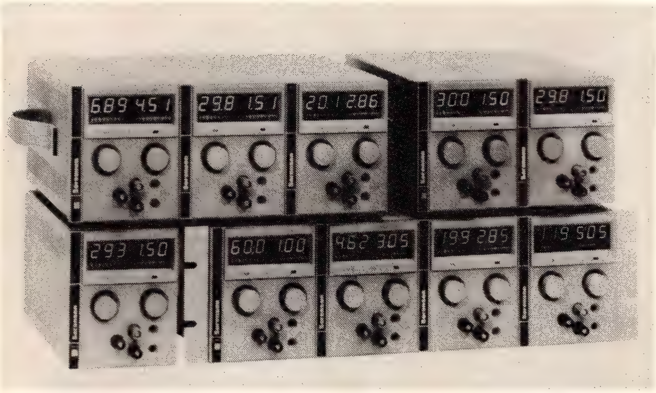


Rack-mountable power-supply interface modules (Lambda Electronics)

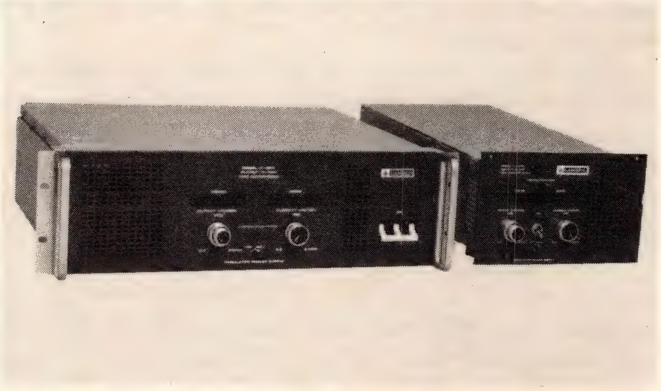
	CONSTANT-CURRENT MODE						
LOAD REGULATION	RIPPLE AND NOISE	TEMPERATURE COEFFICIENT	SOURCE REGULATION	LOAD REGULATION	PROGRAMMING INTERFACES	FEATURES	PRICE
0.005%	N/A	50 PPM/°C	0.001% I_{MAX}	0.005% I_{MAX}	GPIB/BINARY/BCD	F	$3140
0.1% V_{MAX}	1.5 mA RMS	0.03%/°C	0.1% I_{MAX}	0.1% I_{MAX}	GPIB	I, J, K, M	$550
0.01%+3 mV	5 mA RMS	0.02%/°C	0.01%+2 mA	0.01%+3 mA	GPIB	G, I, J, M	$545
2 mV	<1 mA RMS	160 PPM+0.4 mA/°C	0.06%+1 mA	2 mA	GPIB	B, C, D, E, F, G, H, I	$2700
2 mV	<1 mA RMS	160 PPM+0.2 mA/°C	0.06%+1 mA	1 mA	GPIB	B, C, D, E, F, G, H, I	$2700
2 mV	<1 mA RMS	160 PPM+0.4 mA/°C	0.06%+1 mA	2 mA	GPIB	B, C, D, E, F, G, H, I	$3200
2 mV	<1 mA RMS	160 PPM+0.1 mA/°C	0.06%+1 mA	0.5 mA	GPIB	B, C, D, E, F, G, H, I	$3700
0.002%	0.03% RMS*	0.02%/°C	0.005%	1 mA*	GPIB**	F, G, M	$769
0.002%	0.03% RMS*	0.02%/°C	0.005%	1 mA*	GPIB**	F, G, M	$1806
0.002%	0.03% RMS*	0.02%/°C	0.005%	1 mA*	GPIB**	F, G, M	$1724
0.002%	0.03% RMS*	0.02%/°C	0.005%	1 mA*	GPIB**	F, G, M	$2403
2 mV	2 mA RMS	50 PPM/°C	2 mA	2 mA	GPIB	C, K	$995
3 mV	2 mA RMS	50 PPM/°C	2 mA	2 mA	GPIB	C, K	$1250
0.02%+2 mV	N/A	N/A	0.3 I_{MAX}	0.03 I_{MAX}	GPIB	C, L, M	$1773
0.02%+4 mV	N/A	N/A	0.3 I_{MAX}	0.03 I_{MAX}	GPIB	C, L, M	$3046
0.01%+4 mV	N/A	N/A	N/A	N/A	GPIB	D, F, I, J, M	$525
0.01%+200 μV	25 mA	0.01%+4 mA/°C	0.02%+2 mA	0.02%+2 mA	GPIB	F, I, J, M	$1850
0.005%+1 mV	<100 μA RMS	0.009%+1 mA/°C	0.005%+1 mA	0.005%+1 mA	GPIB/RS-232C/BINARY	A, B, C, D	$1995
0.005%+1 mV	<100 μA RMS	0.009%+1 mA/°C	0.005%+1 mA	0.005%+1 mA	GPIB/RS-232C/BINARY	A, B, C, D	$1995
0.005%+1 mV	<100 μA RMS	0.009%+1 mA/°C	0.005%+1 mA	0.005%+1 mA	GPIB/RS-232C/BINARY	A, B, C, D	$1995
0.01%+2 mV	2 mA RMS	1.2 mA/°C	0.02%+500 mA	0.01%+250 μA	GPIB	C, F, H, I, J, M	$490
0.01%+2 mV	2 mA RMS	0.4 mA/°C	0.02%+500 mA	0.01%+250 μA	GPIB	C, F, H, I, J, M	$490
0.01%+2 mV	2 mA RMS	0.1 mA/°C	0.02%+500 mA	0.01%+250 μA	GPIB	C, F, H, I, J, M	$490
7 mV	2.8A RMS	90 mA/°C	0.5% I_{MAX}	1.5A	GPIB	F, H, I, M	$2075
30 mV	93 mA RMS	13.5 mA/°C	0.25% I_{MAX}	113 mA	GPIB	F, H, I, M	$2075
300 mV	9 mA RMS	1.35 mA/°C	0.25% I_{MAX}	12 mA	GPIB	F, H, I, M	$2075

J=ISOLATED OUTPUT TRACKING (MASTER/SLAVE OPERATION)
K=THERMAL OVERLOAD PROTECTION
L=IBM PC COMPATIBILITY (OPTIONAL)
M=REMOTE SENSING
N=AUTOMATIC SELF-TESTING
O=MULTIPLE OUTPUTS

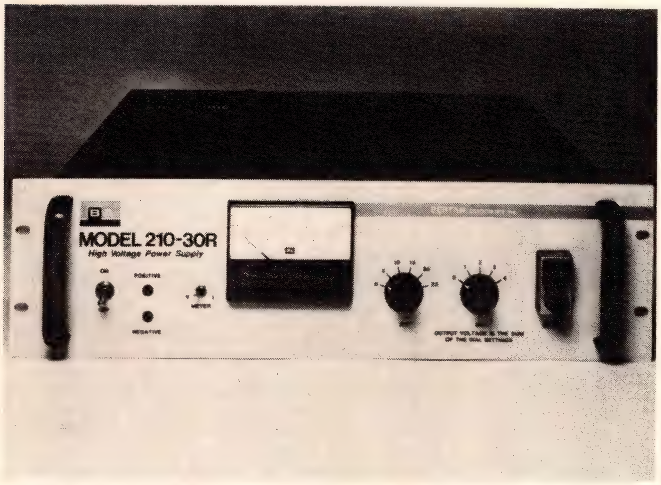
If a little output drifting isn't a cirtical concern for you, you may be able to control your supply's output with just an external resistor.



60W benchtop power supplies *(Sorensen Co)*



3-kW benchtop power supplies *(Lambda Electronics)*



75-kV power supply *(Bertan Associates Inc)*

Certain applications, such as mask repair and microscopy, require high voltages that benchtop power supplies don't ordinarily provide. For such applications, you can use a power supply from Bertan's 210 Series. These supplies offer output voltages reaching 75 kV and output currents approaching 225A. The units measure 5.5×15×17-in. Prices range from $1550 to $3850.

Model 210-30R lets you establish an output voltage between 0 and 30 kV or an output current between 0 and 4.5A. The unit includes remote sensing and remote monitoring. You can order optional digital computer-programming options such as GPIB, 16-bit binary, or 4-decade BCD interfaces. Otherwise, you can control the output via the front-panel knobs or by putting a resistor across the back panel.

Fewer features mean lower prices

Supplies providing only basic functions can cost a good deal less than supplies with many extra features. Power Ten's Series 6101 high-performance supplies, for instance, which offer built-in overvoltage protection, remote programming, remote sensing, and series and parallel operation. The Series 6101 supplies offer voltage ranges from 0 to 40V and current ranges from 0 to 50A. The same company offers the dual-output, 24W Model 2000 supply for $525. This lower-priced model also offers 0 to 40V output, but it yields a maximum output current of only 0.6A. Model 2000 also offers less overvoltage protection than do the higher-priced units.

Electronic Measurements offers the 250W HCR Series power supplies for $550. The HCR300-0.9 offers a 0 to 300V voltage range, but the current range is only 0 to 0.9A. The supply comes with remote sensing and thermal-overload protection. You can order overvoltage protection as an option. A 100W model, the ATR-100, sells for $545. Its output ranges from 0 to 32V and 0 to 10A. The unit comes with overvoltage protection, remote sensing, and thermal-overload protection.

Whether you really need to invest in this additional GPIB-control capacity depends on your application: If you must maintain a precise output, the GPIB control is a necessity; but if a little output drifting isn't a critical concern for you, you may be able to control the output with just an external resistor.

The Kikusui PAR80A and PAR160A power supplies let you use knobs located on the front panels to select constant voltage or current settings. For more extensive control, you have to purchase an optional GPIB interface and a control board. The 80W PAR80A costs $995; the PAR160A offers 160W for $1250. The additional hardware you need to give one of these supplies GPIB capacity adds from $495 to $795.

The Kikusui power supplies offer multiple voltage and current ranges. The PAR80A has four ranges: 0 to 8V at 10A, 0 to 16V at 5A, 0 to 35V at 2.5A, and 0 to

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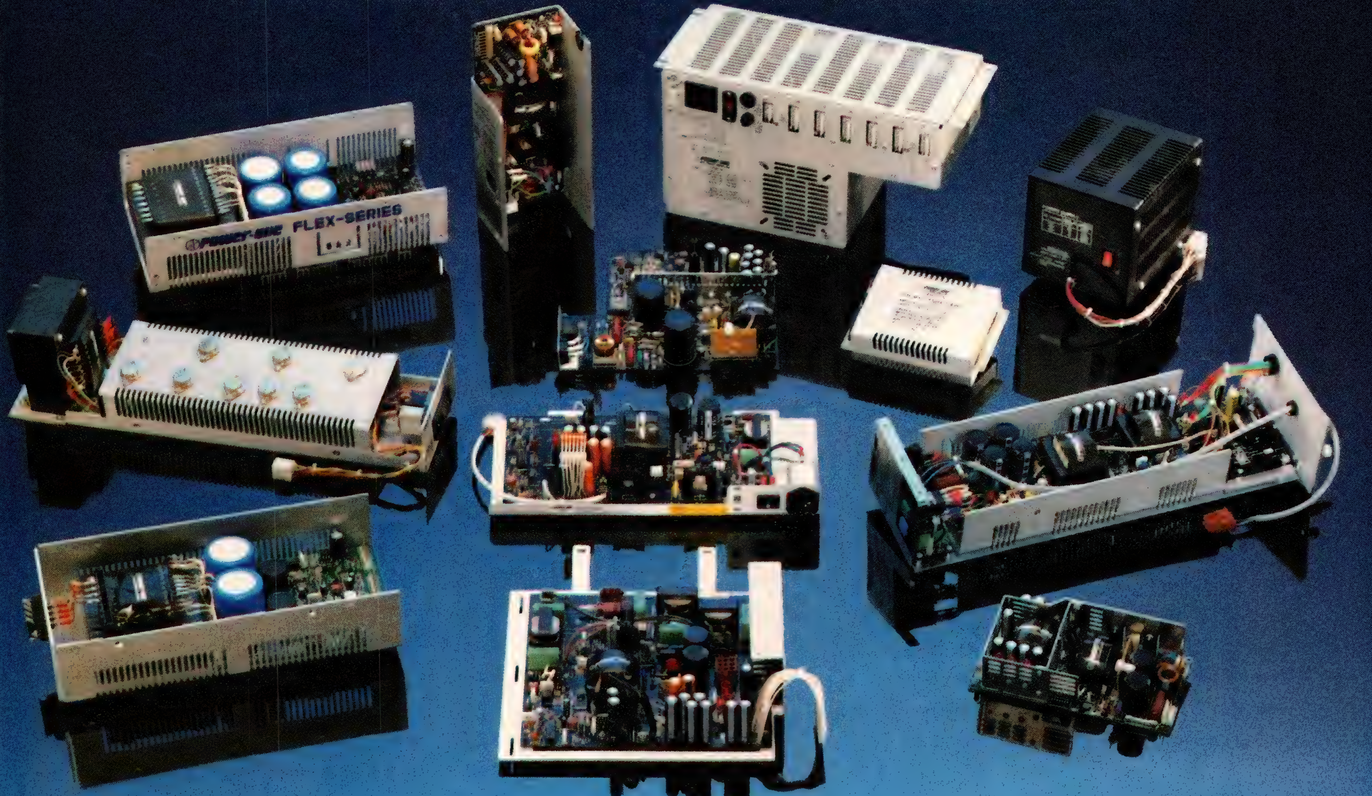

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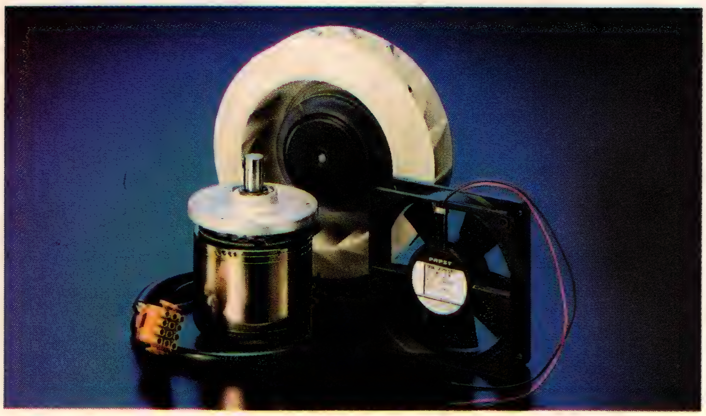

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For more information on the lab and bench power supplies discussed in this article, contact the following manufacturers directly or circle the appropriate numbers on the Information Retrieval Service card.

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(516) 433-3110
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Electronic Measurements Inc
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Circle No 572

Hewlett-Packard Co
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Phone local office
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Flushing, NY 11352
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Gardena, CA 90248
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Circle No 575

Lambda Electronics
515 Broad Hollow Rd
Melville, NY 11747
(516) 694-4200
Circle No 576

Power Ten Inc
486 Mercury Dr
Sunnyvale, CA 94086
(408) 738-5959
Circle No 577

Quality Power Systems
2400 S Texas Ave
Pearland, TX 77581
(713) 997-1700
Circle No 578

Sorensen Co
676 Island Pond Rd
Manchester, NH 03103
(603) 668-4500
Circle No 579

80V at 1A. The PAR160A provides three ranges: 0 to 16V at 10A, 0 to 35V at 5A, and 0 to 80 at 2A. Both models feature digital LED output monitors for voltage and current, coarse- and fine-adjustment knobs, and a fan for thermal-overload protection. You can fit three of these supplies side by side in a single 19-in. rack-mount chassis.

Finally, Kepco's Power Manager supplies permit programming of voltage or current via an optional GPIB interface module. One member of the family furnishes 0 to 325V at 0 to 0.8A; features a 1-kHz bandwidth and a 150-μsec time constant; and costs $1806. **EDN**

Article Interest Quotient (Circle One)
High 476 Medium 477 Low 478

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Because you demanded it, we created it—a switching power supply that delivers 500 watts. This makes it perfect for military radar, communications, electronic countermeasures equipment and TTL logic applications. The big news is its small size. A 3½" profile gives it an unbeatable 2 watt/cubic inch power density.

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Input voltage	*115V or 230 V ac ± 10%*
Output power	*500 watts, (5 V, 12 V, 15 V, 28 V)*
Switching frequency	*100 kHz*
Efficiency	*65% minimum*
Holdup time	*20 mSec*
Ripple and Noise	*100 mV peak-to-peak maximum*
Line and Load regulation	*0.2% and 0.2%*
EMI	*Meets MIL-STD-461B*
Environment	*Meets MIL-STD-810C and MIL-S-901C*
Input protection	*Meets MIL-STD-704*
Operating temperature range	*0°C to +71°C*
Storage temperature range	*−55°C to +85°C*

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MILITARY POWER SUPPLIES

CIRCLE NO 71

OUR QUARTER-POUNDER OF POWER

Military 100 Watt DC-DC Converters

- Weight: ¼ pound
- Size: 4 cubic inches
- Power: 100 Watts
- Density: 400W/lb & 25W/in³
- Switching Frequency: 1 Megahertz

Inland Power Technology serves up state-of-the-art DC to DC converter technology. Encapsulated 4 ounce, 4 cubic inch modules that supply up to 100 Watts of low noise, tightly regulated DC power.

They're built to meet the requirements of MIL-STD-810A for shock, acceleration, vibration, altitude, humidity and salt spray. Reliability is exceptional with a calculated MTBF of over 200,000 hours at 80°C per MIL-HDBK-217D.

These mighty 100W modules are designed especially for portable, vehicle and airborne applications where high efficiency and small size and weight are important. Standard input voltages which cover the range from 10Vdc to 370Vdc are available with outputs from 2Vdc to 100Vdc.

We can also configure complete power systems with output powers in excess of 2KW and power densities up to 47 W/in³. For example, a triple output system with 5V @ 105 A & ± 15V @ 6.7A has a volume of only 24 in³ and weighs a mere 1½ lb.

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Inland Motor Division
Kollmorgen Corporation

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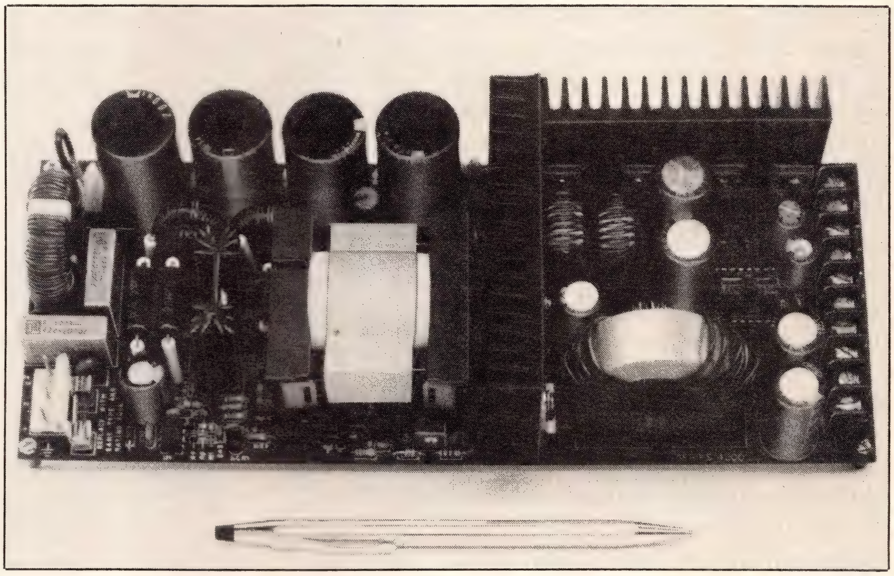
Phone: (602) 459-1150 • TWX: 910-973-9869

CIRCLE NO 104

Series of switching power supplies delivers 200W in various output combinations



4200 Series switching power supplies provide 200W continuous power and boast current-mode control. You can choose from four models delivering 5V dc and having auxiliary outputs of 12, 15, 24, or −5V dc; each model resides on a 4×10×2.2-in. pc board. All units meet the safety requirements of VDE, UL, and CSA and contain an onboard EMI filter that satisfies the requirements of VDE level B specs.

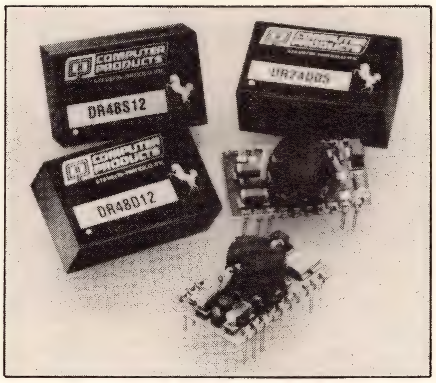
The supplies guarantee an operating efficiency of 70% over the 0 to 70° temperature range; natural convection provides cooling. Minimum holdup time is 16 msec, and line regulation is ±0.1%. The supplies can achieve load regulation as low as ±0.5%. Output overvoltage protection, input line fusing, soft start, and indefinite short-circuit protection are standard.

Two switchers, Models 4200-3 and 4200-4, feature regulated auxiliary outputs. User-selectable input voltage ranges encompass 90 to 130V ac or 180 to 250V ac. Price for any of the four models is $249. An L-frame bracket costs an extra $25, and a cover costs another $35. Delivery, stock to eight weeks ARO.

Power General, Box 189, Canton, MA 02021. Phone (617) 828-6216. TWX 710-348-0200.

Circle No 580

DC/dc converters with a 2:1 input range come in DIP-sized packaging



This family of dc/dc converters, the DR Series, maintains regulated single and dual 2.5 and 3W outputs over a 2:1 input voltage range. Enclosed in packages measuring 1.25×0.80×0.5 in., these converters are compatible with a DIP footprint. They include a π input filter, current-limit protection at 120% of full rated load, output overvoltage clamping at 125% of full rated output, and short-circuit protection.

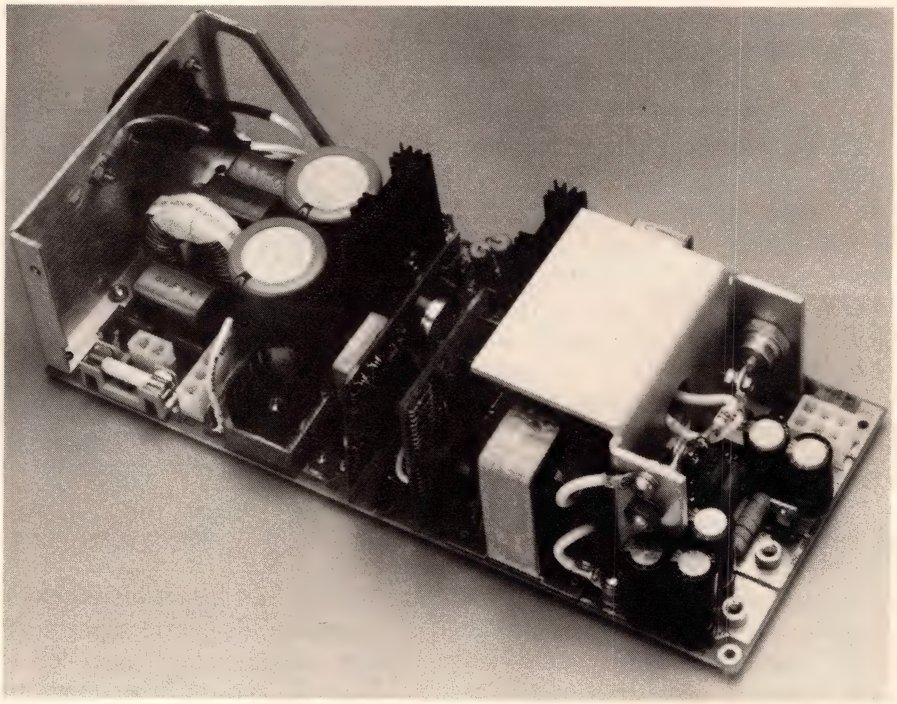
Depending on the model, the converters accommodate inputs of 18 to 36V dc (24V dc nominal) or 36 to 72V dc (48V dc nominal). Six models are available in each input voltage range: Single-output models offer 5V at 500 mA, 12V at 250 mA, and 15V at 200 mA; dual-output versions offer ±5V at ±250 mA, ±12V at ±125 mA, and ±15V at ±100 mA.

The family claims an efficiency of 82% and an MTBF of 266,000 hours. Line regulation is ±1.0% typ over the 2:1 input range, and load regulation is ±1.0% over a full-load to quarter-load range. For single-output family members, output ripple and noise is 100 mV p-p max; for dual-output models, output ripple and noise are 150 mV p-p max. Isolation voltage is 500V dc min, resistance is 1×10^{7}Ω min, and capacitance is 300 pF. Utilizing convection cooling, the series operates over ambient temperatures spanning −20 to +71°C. $45.50 (100). Delivery, eight to 12 weeks ARO.

Computer Products Inc, Power Conversion Group, 2981 Gateway Dr, Pompano Beach, FL 33069. Phone (617) 268-1170.

Circle No 581

Two-output, 250W switcher offers MTBF exceeding 75,000 hours



In accordance with MIL-HDBK 217-D, Model H2ANL0512 has demonstrated an MTBF exceeding 75,000 hours. This 2-output, 250W switcher is certified for applicable FCC, CSA, UL, TUV (VDE), and IEC standards for safety and EMI criteria. The unit's ac input ranges are 90 to 132V ac or 180 to 240V ac, single phase, 49 to 61 Hz. DC outputs are 5 and 12V. Output ripple and noise are 1% V_{OUT} p-p or 100 mV p-p, whichever is greater.

Operating at ambient temperatures of 0 to 50°C, the MOSFET switcher requires forced-air cooling of 200 lfm (linear feet/minute) for maximum output. Other features include overload, overvoltage, input-surge-current (soft-start), input-EMI, and brown-out protection. A power-fail signal is also standard.

Line regulation is ±0.4% V_{OUT} max over the input range for a 5V output and ±1% for a 12V output; load regulation is ±0.4% max for a 5V output and 4% for a 12V output. The manufacturer claims the switcher has a typical efficiency of 72%. Holdup time is 40 msec typ. Model H2ANL0512 costs $232 (1000). Delivery, eight weeks ARO.

NCR Power Systems, 3200 S Lake Emma Rd, Lake Mary, FL 32746. Phone (800) 327-7612; in FL, (305) 323-9250.

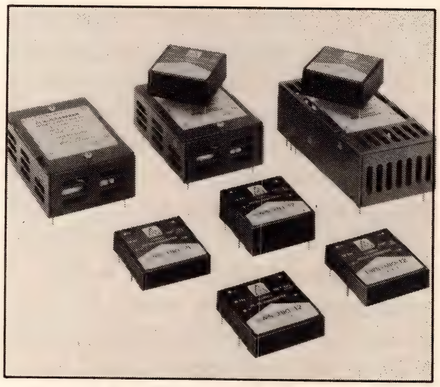
Circle No 582

Single- and dual-output dc/dc converters eliminate potential ground-loop problems

Twenty single- and dual-output dc/dc converters bring the total number of units in the LW Series to 48. The single-output converters are available in ratings from 10 to 60W in wide-range input and adjustable wide-range output models. Narrow-range-input, single- and dual-output models come in 3 and 6W packages.

Depending on your application and the version of dc/dc converter you choose, efficiency ranges from 50% min (Models LWS-193, -194, -294-, -394) to a 75% min (Models LWS-296, -397). Isolation rating is 1500V dc for Models LWS-394, -395, and -397; for all other converters, it is 500V dc. Line and load regulation specifications also depend on the unit. Line regulation equals 0.1, 0.2, or 0.5%; load regulation can be 0.2, 0.4, or 1.0% (no load to full load).

All twenty models have external overload protection, convection cooling, and automatic current-limiting circuits that limit the output current to a preset value. All are suitable for pc-board mounting. DC inputs and outputs are via pin-type connections. Prices start at $21.

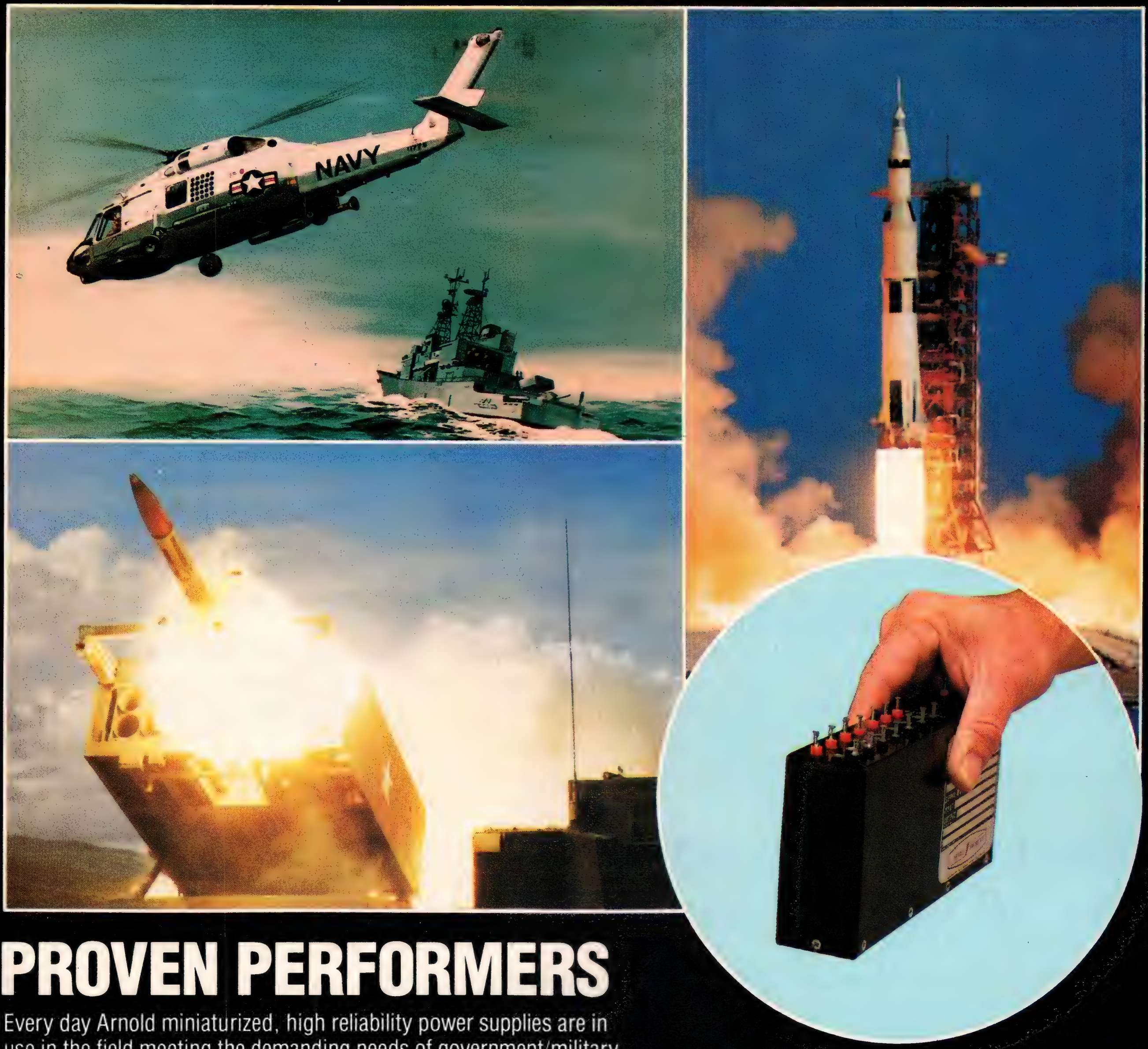


Lambda Electronics, 515 Broad Hollow Rd, Melville, NY 11747. Phone (516) 694-4200.

Circle No 584

EXTENDED RELIABILITY

POWER SUPPLIES



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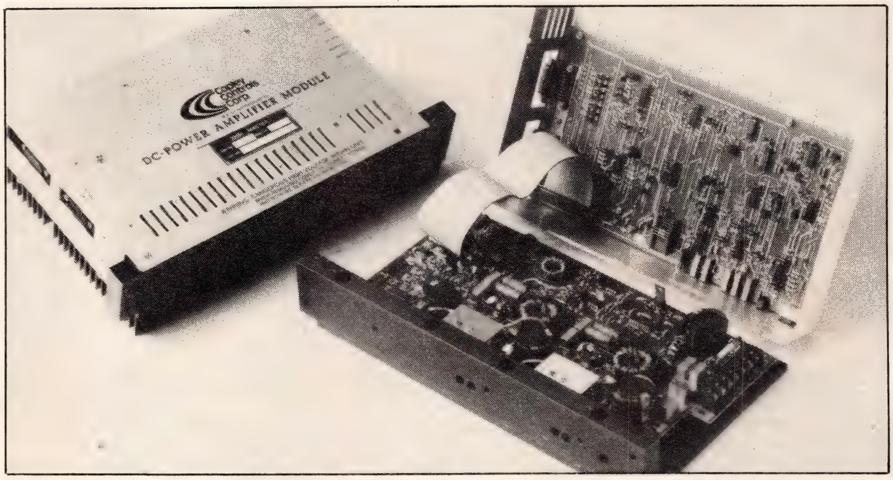
CIRCLE NO 72

PWM amplifier measures 7.7×12.9×2.25 in. and delivers 1.1 kW of continuous power



The wideband Model 220-10 PWM amplifier is a 4-quadrant dc- to 10-kHz power source capable of delivering 1.1 kW (15A, 75V) continuous or 1.6 kW short term. You can parallel several amplifiers in a master/slave configuration to deliver 30W (450A, 75V) continuous or 48 kW peak.

The amplifier combines efficiency and compactness: It measures 7.7×12.9×2.25 in. and operates at 92% efficiency. PWM switching frequency is 80 kHz, whereas frequency response is 10 kHz. The module's switching frequency simplifies the design and minimizes the size of the internal filter necessary to smooth the 80-kHz output pulses into an amplified replica of the amp's input. The 80-kHz ripple appearing in the output is less than 1% at full load.

Linearity measures 0.05% from dc to 700 Hz, and distortion is 1% over the dc to 10-kHz frequency range. The amplifier's low dissipation permits it to operate from 0 to 60°C with no derating. In addition, built-in protection prevents amplifier damage caused by overload, short circuits, or excessive temperature rise.

A slave unit, Model 220S-10, costs $975. Model 220M-10, a master capable of controlling as many as 30 slaves for 30-kW output, costs $1060. Delivery, four to six weeks ARO.

Copley Controls Corp, 375 Elliot St, Newton, MA 02164. Phone (617) 965-2410. TLX 285957.

Circle No 583

Lithium batteries retain 90% capacity after 10 years of storage at 21C

These two lithium inorganic batteries, the TL-5261 and the TL-5263, provide standby power for as long as 10 to 15 years in applications such as memory backup. Corrosion-resistant Noryl Se90 packages protect the batteries, and the shape of the packages facilitates the use of automatic placement and insertion equipment.

The TL-5263 measures 0.9×0.9×0.3 in. and weighs 0.25 oz. Electrical properties include the following: an open-circuit voltage of 3.7V, a rated capacity of 0.35 Ahr, a rated current of 0.10 mA, and a maximum current of 0.70 mA.

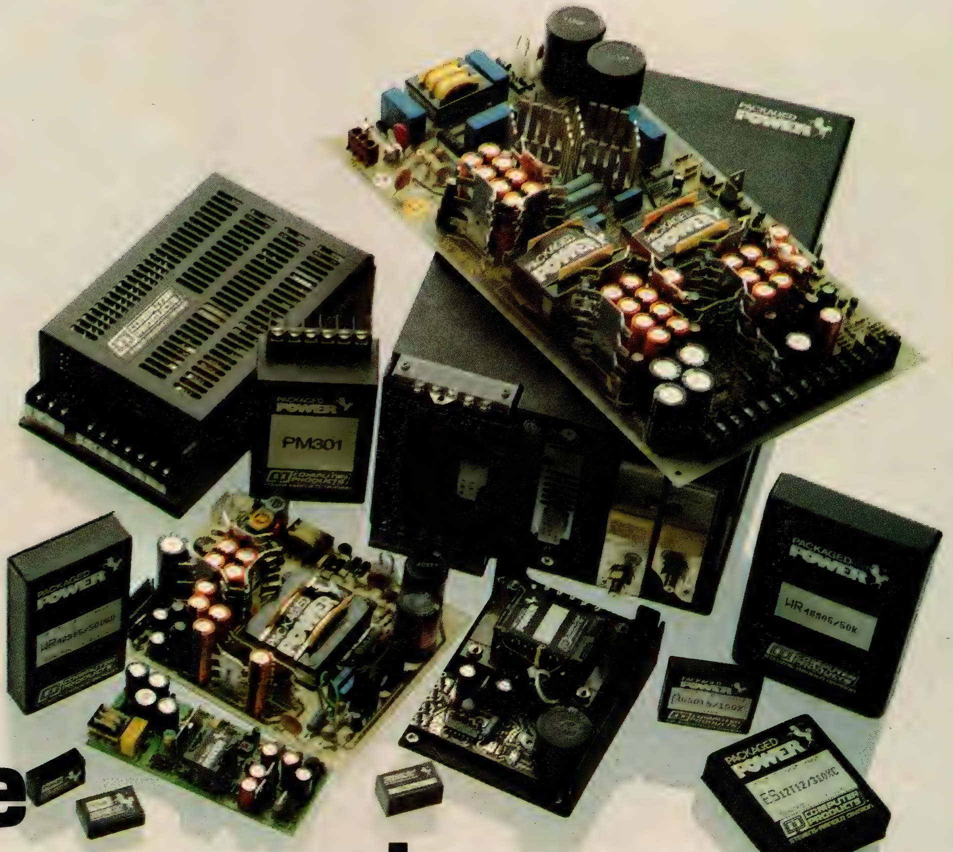
The TL-5261 weighs 0.63 oz. Its dimensions are 1.3×1.3×0.31 in. Electrical characteristics are as follows: 3.7V open circuit voltage, 1.0-Ahr rated capacity, 0.1-mA rated current, and 0.7-mA max current.

For both batteries, the following MIL standards comply: solderability as per MIL-STD-202F, method 208D, 210A; terminal strength as per MIL-STD-2021F, method 211A; salt-spray testing as per MIL-STD-202F, method 101D; and dynamic environmental testings as per MIL-STD-202F, method 204D, 205E. The batteries have a maximum capacity loss of 10% over 10 years of storage at 21°C. Prices start at less than $4 (OEM qy).

Tadiran Electronic Industries Inc, 40 Seaview Blvd, Port Washington, NY 11050. Phone (800) 367-6859; in NY, (516) 621-4980. TLX 6973370.

Circle No 585

One half million more power supplies...



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Adding Boschert makes us the Biggest Name in power supplies! Boschert, the leading name in open-frame switchers, will produce more than a half million units in 1986. Boschert is the newest member of the Power Conversion Group of Computer Products Inc. — the name no one knows.

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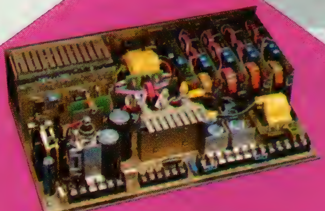
CIRCLE NO 73

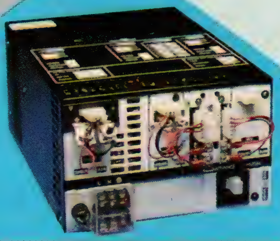
You design the product.

Let Advance supply the power.

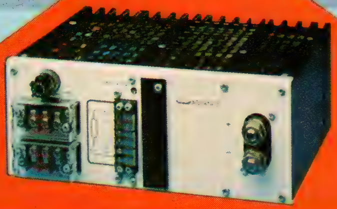
5/300 High Power — 5″ x 8″ x 11″ ■ 5V/300A/1500 watts ■ Built-in load sharing and paralleling circuit.



Powerflex — Up to 5 outputs ■ 500 watts continuous /750 watts surge ■ Inputs of 115/230 VAC or 48 VDC

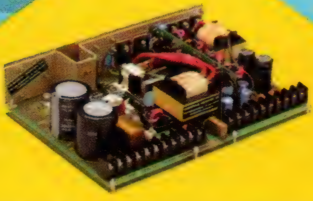


Hiflex — 5″ x 8″ x 11″ ■ Up to 6 independent outputs ■ To 1000 watts



MG — Demonstrated MTBF in excess of 125,000 hours ■ Single outputs from 5V-60V/100 watts to 500 watts ■ High-density convection cooled packaging

Multi High Power — 5″ x 8″ x 11″ ■ Mix and match up to 5 outputs ■ To 1000 watts



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When designing around any one of the single- or multiple-output, open or closed Advance switching power supplies, you won't have to worry about compromising the overall quality of your product. These reliable switchers deliver from 180 to 1500 watts of full power in any voltage combination you may require.

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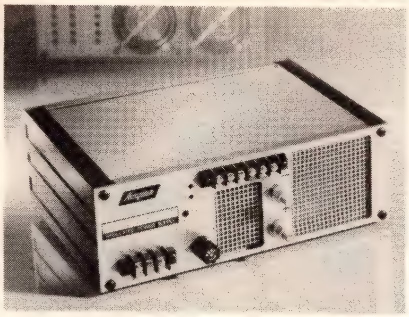
CIRCLE NO 74

703-003-1

Power Sources



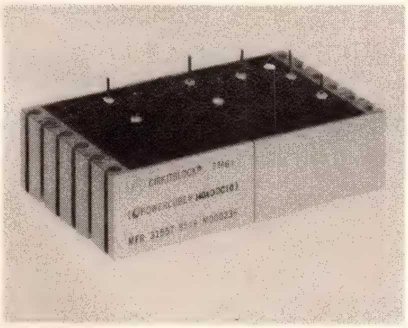
750W SWITCHERS

These Series W switching power supplies offer outputs of 5V dc (150A), 12V dc (68A), 15V dc (54A), 24V dc (38A), 28V dc (32A), and 48V dc (19A). All models feature status indicators, overvoltage protection, and soft-start operation. Line and load regulation are both ±0.5%, noise and ripple are less than 10 mV rms (50 mV p-p for the 5V model), and efficiency is typically 76%. Standard models operate on inputs of 90 to 130V ac, 49 to 61 Hz, but an input of 180 to 264V ac is optional. I/O isolation is 1400V dc.

You can inhibit the output by applying between 2 and 30V dc to the inhibit terminal. Enclosed in cases finished in flat black and gold alodyne, these supplies measure 3.4×0.3×7.9 in. They operate over an ambient range of 0 to 71°C and utilize forced-air cooling. $995.

Acopian Corp, Box 638, Easton, PA 18044. Phone (800) 523-9478; in PA, (215) 258-5441.

Circle No 588



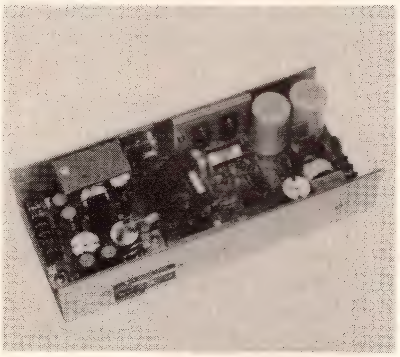
AC/DC CONVERTERS

Two miniature ac/dc converters, Models 140ADDC10 and -AYDC30, accept 3-phase, 115V ac input and convert it to the 110 to 160V filtered dc output required by the company's Icecube dc/dc supplies. Packaged in anodized cases conforming to MIL-A-8025-II, class 2, the converters are intended primarily for military and aerospace applications.

Model 140ADDC10 provides 100W, and Model 140AYDC30 provides 400W. The converters take up 2×4 in. of board real estate and are 1 and 1.95 in. high, respectively. Their respective weights are 14 and 22 oz. Compared with standard 60-Hz ac sources, these modules have an efficiency approaching 98%. For the 140ADDC10, ripple at V_{IN} nominal and rated load is 12V p-p (max) at 25°C; for the 140AYDC30, it's 10V p-p. Both units accept positive transients equivalent to MIL-STD-704A/B. 140ADDC10, $375; 140AYDC30, $245. Delivery, nine to 11 weeks ARO.

Powercube Corp, 8 Suburban Park Dr, Billerica, MA 01821. Phone (617) 667-9500. TWX 710-347-6792.

Circle No 587



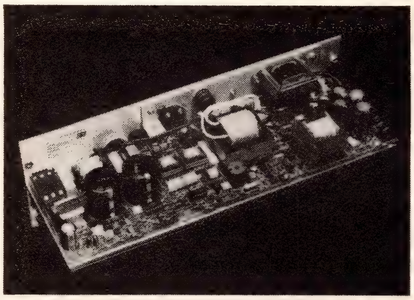
300W, 400W SUPPLIES

The MDX Series comprises 300 and 400W switching power supplies capable of accepting 90 to 132V ac or 180 to 264V ac, 47 to 63 Hz. Brownout protection holds output regulation down to 85 or 170V ac inputs. The switchers' 8- or 4-mm spacing meets international safety standards, including CSA 22.2, IEC 380, and VDE 0806, class 1, SELV. They are also UL478 recognized and TUV certified. Conducted RFI fulfills the requirements of FCC part 15, subpart J, and VDE 0871, class A.

The series offers overload and overvoltage protection. Current-limit protection is standard on all outputs; the switchers recover automatically when a fault is removed. For each supply, the main output is protected against overvoltages induced by the power supply to a maximum of 6.8V. Efficiency is 75% typ, holdup time is 16 msec min, and operating range is 0 to 50°C full load (70°C half load). To achieve full-load ratings, 30 cfm of air is requisite on all models, except 70A units, which require 60 cfm. $377 (100).

Todd Products Corp, 50 Emjay Blvd, Brentwood, NY 11717. Phone (516) 231-3366.

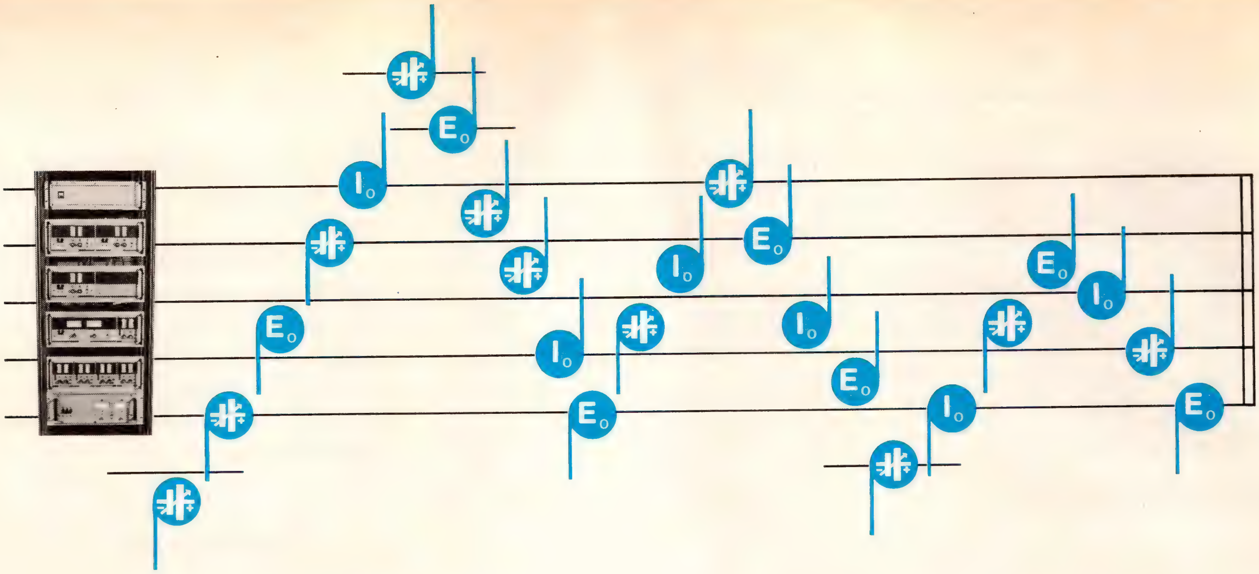
Circle No 586



4-OUTPUT SUPPLY

The SQV402 quad-output switcher meets international requirements for isolation and EMI/RFI specifications. Built-in line filtering meets FCC and VDE 0871, level A stipulations. The supply's input capability is 90 to 132V ac or 180 to 264V ac, 47 to 440 Hz, and it withstands 3750V ac I/O isolation (4-mm spacing primary to ground, 8-mm spacing primary to secondary).

The 5V main output's rating is 50A. Of three auxiliary outputs included, one is capable of 10A (16A peak), and the other two have a capability of 5A. Output voltage for these two auxiliary outputs is 5, 12, 15, or 24V; output voltage for the 10A output is 12 or 24V. The supply has overload, overvoltage, and thermal-shutdown protection as well as



How to make power dance to the most complex tune you can dream up.

Kepco Power Management Systems™ control voltage to 0.001% and current to 0.005%, and respond to programming step changes in as little as 3 microseconds. They offer the most precise, the most flexible control of power you can buy.

Kepco Power Management Systems consist of components that work perfectly together because they were *designed* to work perfectly together: Kepco Power Managers and Kepco Digital Interfaces.

The Kepco Power Managers are linear programmable power supplies which have been especially designed for programming applications. Their voltage and current can be controlled from zero through their entire range; they can give you maximum rated voltage *and* maximum rated current *simultaneously;* and they can scale a uniform 0-1V or 0-10V control signal into any desired output within their range.

The Kepco Digital Programming Interfaces were created to take full advantage of the Power Managers' precision and speed of response, by allowing them to be controlled by a computer or digital controller. They translate 12-bit digital signals into a 0-1V or 0-10V variable d-c signal, and are guaranteed monotonic to within 1/2 LSB or 0.012%.

There are 12 series of Power Managers, each with its own characteristics.

Series ATE, for example, offers full external control over both voltage and current with automatic crossover; and user selectable *slow mode* for stabilizing voltage, and *fast mode* for stabilizing current and following high speed programming.

Series BOP is fast programmable and also bipolar, which means its voltage and current outputs are smoothly adjustable from −100% to +100% of their ratings, passing through zero without a glitch. The output of our model BOP 100-1M can go from −100V to +100V in 66 μsec, and from −1A to +1A in 90 μsec.

Our TLD Digital Programmer not only passes commands to Power Managers from a computer or digital controller, but also passes responses from the Power Managers back to the computer. It can control up to 16 Power Managers at once.

Our Series SN are stand-alone interfaces, with models available for use with the IEEE bus, or, for fast programming buses using bit-parallel data transfer. Series BIT are cards which plug into the BOP Power Managers.

The Kepco Power Managers are computer-tested and delivered fully zeroed and calibrated, for easy mating with any SN or TLD programmer and quick assembly into an operating system.

Call or write Dept. JLB-12,
KEPCO, INC., 131-38 Sanford Avenue,
Flushing, NY 11352 USA
(718) 461-7000 • TWX #710 582 2631
FAX (718) 767-1102.

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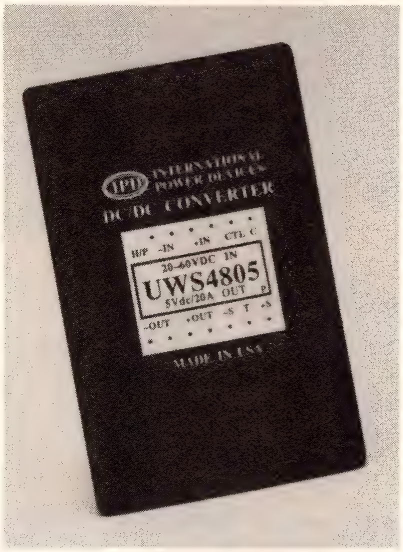
KEPCO'S 40TH YEAR
1986

CIRCLE NO 105

a remote-sensing capability. The unit measures 5×15×2.5 in. and costs $330 (100). Delivery, 8 to 10 weeks ARO.

Switching Systems International, 1827 N Case St, Orange, CA 92665. Phone (714) 921-1153. TWX 910-593-1339.

Circle No 589



DC/DC CONVERTERS

The UWS Series comprises 100 and 120W single-output dc/dc converters, which are available as either stand-alone or master and slave modules. A master module can drive as many as four slaves to provide a total of 600W with less than 10% load-sharing deviation on each module. Master and slave modules include synchronization pins. Input voltage range is 20 to 60V dc, ie, a 3:1 ratio.

These current-mode-control converters operate at 200 kHz with an efficiency approaching 83% (at full load). An LC input filter is standard. Ripple and noise are 75 mV p-p over a 20-MHz bandwidth, transient response is less than 200 μsec for a 50% load change, and the temperature coefficient is ±0.02%/°C. All units will sustain indefinite short circuits. Load regulation is 2% max (full load to no load), and line regulation is 0.5% max (low line to high line). Six-sided metal cases encapsulate the supplies and eliminate noise radiation; the cases measure 3.5×5.5×0.91 in. (before mounting and without heat sinks). $249.

International Power Devices Inc, 155 N Beacon St, Brighton, MA 02135. Phone (617) 782-3331. TLX 650-273-8631.

Circle No 594

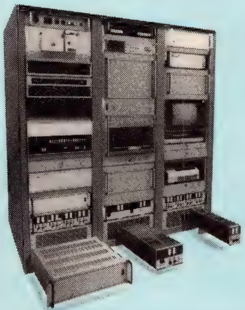
5-OUTPUT SUPPLIES

The VF Series fan-cooled switching power supplies offer power densities greater than 3W/in^3 and are available in versions providing 500 to 1750W and one to five outputs. The units meet all VDE, IEC, UL, CSA, BP, ECMA, and CEE safety requirements, including 3750V ac dielectric isolation and 8-mm spacing from primary to secondary circuits. In addition, they comply with FCC and EMI requirements. VDE, UL, and CSA certification is in process.

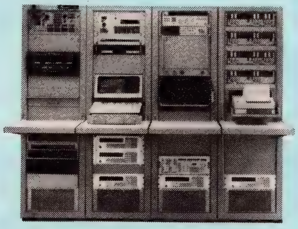
The line provides current-sharing parallel operation and true redundant operation—no isolation diodes are necessary and no derating is required for parallel or redundant service. Typical efficiency is 80%. Protection features include reverse voltage, thermal shutdown, overvoltage, foldback current limiting, inrush current limiting, and line-spike suppressors. Operating temperature for the supplies is 0 to 70°C; derating of 2%/°C occurs above 50°C. Line and load regulation are 0.4% for changes from minimum to maximum rated values. Ripple and noise are 1% or 100 mV p-p over a 20-MHz bandwidth. $220 to $845

KEPCO POWER MANAGEMENT SYSTEMS™ AT WORK

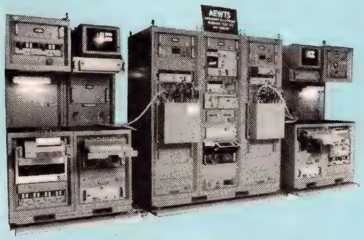
System put together, tested and delivered by Kepco, consisting of one TLD 488-16 controlling five quarter-rack, three half-rack, and one full rack ATE Power Manager.



Grumman CAT™ Test System incorporating one SNR 488-8 controlling 11 ATEs.



Harris Corporation AAN/USM-484 Hybrid Test System with one single channel SN 488-12 controlling 10 ATEs.



Honeywell AEWTS and ETS Tests Sets include one SNR 488-8 to control varying numbers of ATEs.

For 144-page Kepco Applications Handbook and Full Line Catalog, call/write Dept. JLB-12, KEPCO, INC., 131-38 Sanford Avenue, Flushing, NY 11352 USA • (718) 461-7000 TWX #710 582 2631 • FAX: (718) 767-1102.

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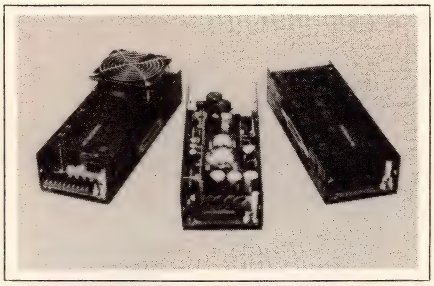
CIRCLE NO 84

(OEM qty). Delivery, four to eight weeks ARO.

Deltron Inc, Box 1369, North Wales, PA 19454. Phone (215) 699-9261. TWX 510-661-8061.

Circle No 598



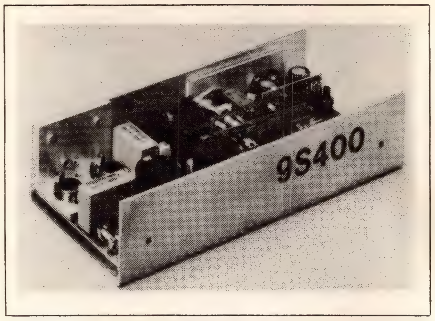
5-OUTPUT SWITCHER

The Model 29 switching power supply features five isolated, floating outputs; current-mode regulation; and automatic current sharing. You can parallel individual outputs with each other; they will automatically share current in direct proportion to their current ratings. Isolation diodes minimize the possibility that a failed supply will cause a system failure.

Model 29D has a rating of 200W with convection cooling and a rating of 300W with forced-air cooling. When using forced-air cooling, the main output can deliver 40A at 5V dc. The auxiliaries provide output voltages ranging from 5 to 24V dc and currents from 3 to 6A continuous and 4 to 9A peak. $464. Delivery, four to eight weeks ARO.

Powertec Inc, 20550 Nordhoff St, Chatsworth, CA 91311. Phone (818) 882-0004.

Circle No 590



400W SWITCHER

The 9S400 single-output switcher uses 200-kHz PWM techniques. The 400W device is UL 478 recognized and certified to CSA 22.2 (#154 approved to VDE 0806 (IEC 380)) for SELV applications. It also complies with FCC Docket 20780, level B, and VDE 0871, level B, for conducted EMI. The supply is protected against overload, short-circuit, reverse-polarity, overvoltage, and overtemperature conditions. However, additional cooling via conduction or forced air is required for continued operation at full rated loads. You can adjust output voltages to ±5% (min). Dual wide-range input voltage is 90 to 132V ac or 180 to 264V ac, 47 to 63 Hz.

Around the world Ion Implantation Equipment is being powered by the new 4800 Series HV Power Supplies.

The 4800 kW system has been designed to the leading edge of HV technology, and offers hitherto unattainable standards of flexibility and stability.

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FLEXIBILITY—Vicor converters support applications ranging from low power battery equipment to multi-kilowatt off-line power systems with input voltages from 10 to 425 VDC, and isolated outputs from 5 to 48 VDC. Booster modules allow you to configure power systems that are expandable in 200W increments.

RELIABILITY—With 50,000 modules in the field over a year, the failure rate is less than 0.1%.

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VI-100™ Converters and VIB-00 Power Boosters™, manufactured by Vicor and its licensees, represent the state-of-the-art in power conversion technology. See what smaller size, higher efficiency, and modular component flexibility can do for your next power system design. Call (0734) 868567, TWX: 847073 POWLIN G, FAX: (0734) 755172.

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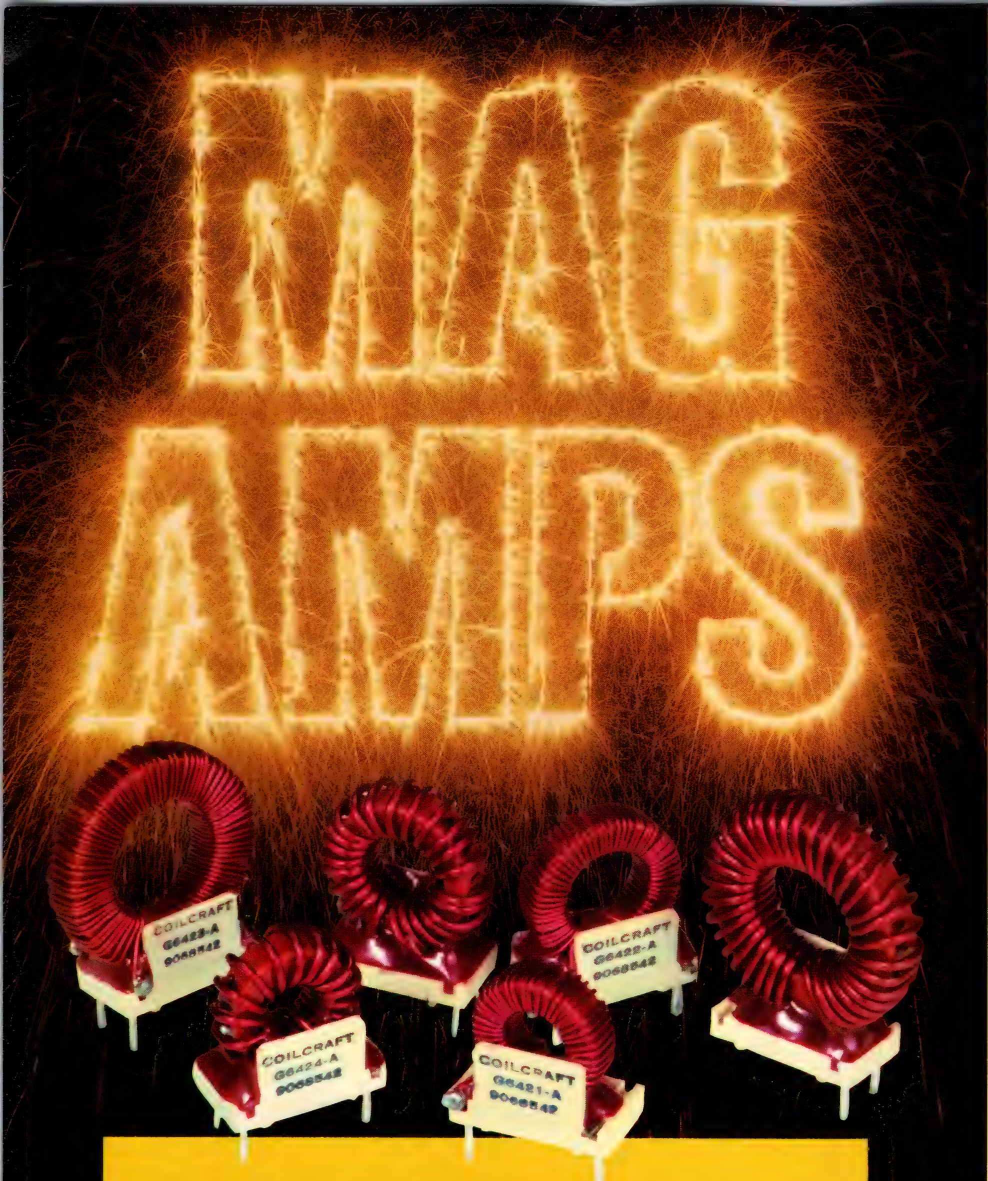
CIRCLE NO 108



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Coilcraft

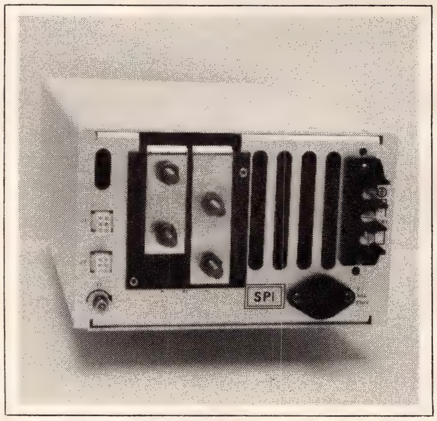
Dept. D, 1102 Silver Lake Rd.,
Cary, IL 60013 312/639-6400

CIRCLE NO 162

Four configurations are available: 5V, 80.0A; 12V, 34.7A; 15V, 28.2A; and 24V, 18.0A. The 5V model includes a power-fail signal that provides a 5-msec warning prior to the loss of dc power in the event of ac power loss. For all configurations, line regulation is 0.2% for a low- to high-line change; load regulation is 0.2% for a 0 to 100% load change. Holdup time is 20 msec min, and ripple and noise are 50 mV p-p max. $300 or $500 (OEM qty). Delivery, 12 to 16 weeks ARO.

Sierracin/Power Systems, 20500 Plummer St, Chatsworth, CA 91311. Phone (818) 998-9873.

Circle No 591



2000W SUPPLY

This 2000W addition to the SV Series delivers full power at 50°C and includes a power-fail signal and overtemperature and short-circuit protection. Its circuitry guarantees equal load sharing; loads from 25 to 800A can share current within 5% when using two 5V dc, 400A supplies. You can choose from 2 and 5V, 400A; 6V, 335A; 12V, 200A; 24V, 100A; and 48V, 50A versions. All models are UL recognized and CSA certified.

Operating range is 90 to 132V ac or 180 to 264V ac; frequency is 47 to 63 Hz, single phase; and nominal ac input is 100, 115, 208, or 230V. The switcher's load regulation is ±0.5% for 10 to 100% load changes; its line regulation is also ±10% for ±15% line changes around nominal 115 to 230V ac. Ripple and noise are 100 mV p-p (47-Hz to 50-MHz bandwidth). $1449 (100).

Switching Power Inc, 3601 Veterans Hwy, Ronkonkoma, NY 11779. Phone (516) 981-7231.

Circle No 592

COMPACT SUPPLY

The Powermag A1500 switching power supply offers a dc output of 5V at 300A continuous. You can adjust the output from 4.5 to 5.5V via an internal potentiometer or from 2 to 6V via remote programming. In addition, you can connect virtually any number of supplies in parallel.

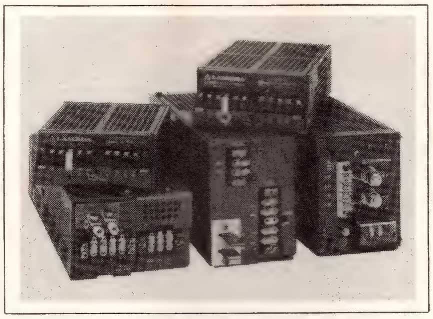
Enclosed in an 8×5×11-in. box, this fan-cooled switcher delivers 3.4W/in^3 from either 110 or 220V nominal, 47 to 440 Hz. Typical efficiency is 70%. Standard specifications include soft start; overcurrent, overvoltage, and overtemperature protection; margin testing; local and remote sensing; and full-cycle hold-up for a 5V output, 300A output at 50 or 60 Hz. Ripple and noise are less than 100 mV p-p over a 30-MHz bandwidth, and worst-case static regulation is 0.4%. $900 (100).

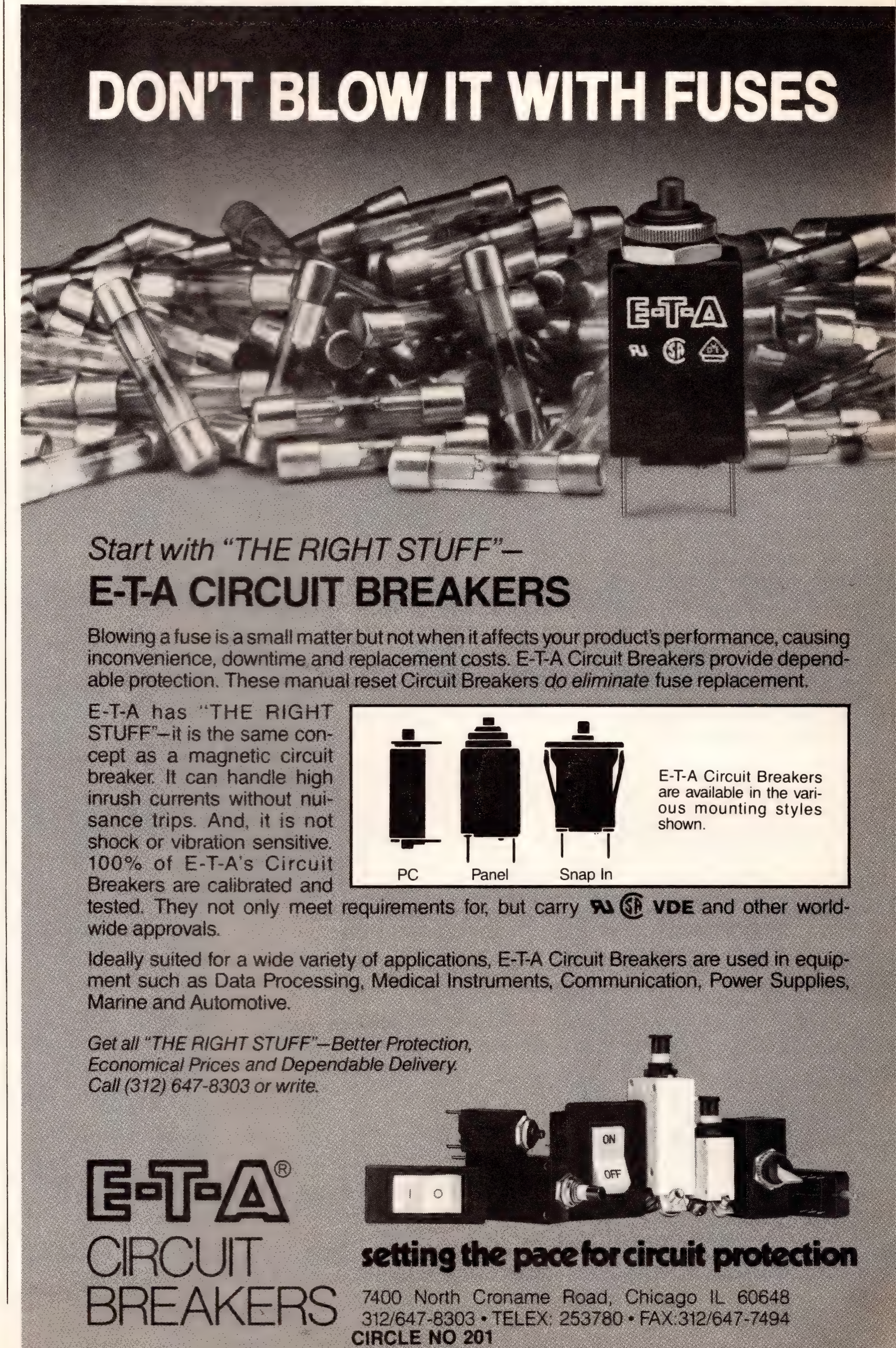
Advance Power Supplies Inc, 32111 Aurora Rd, Solon, OH 44139. Phone (216) 349-0755.

Circle No 593

400W SUPPLY

The LRS-56 supplies 2.5W/in^3 and has an integral EMI filter, which provides the protection necessary to meet MIL-STD-461A and FCC Docket 20780, class A. The switcher is under evaluation for UL/CSA approval. AC input line is 95 to 132V ac, 47 to 440 Hz. Line regulation is 0.1%, and load regulation is 0.1% from no load to full load. The 48V version's ripple and noise specifications are 35 mV rms, 150 mV p-p. This switching power supply operates at continuous duty from −10 to





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Blowing a fuse is a small matter but not when it affects your product's performance, causing inconvenience, downtime and replacement costs. E-T-A Circuit Breakers provide dependable protection. These manual reset Circuit Breakers *do eliminate* fuse replacement.

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CIRCLE NO 201

+71°C, with suitable derating above 40°C.

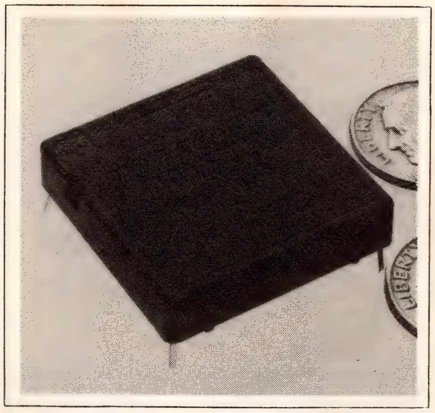
Overvoltage protection is standard. In addition, it offers external overload protection and current limiting. A self-resetting thermostat provides thermal protection. The supply is convection cooled and measures 4⁷⁄₁₆×4⅞×11½ in. $725.

Lambda Electronics, 515 Broad Hollow Rd, Melville, NY 11747. Phone (516) 694-4200. TWX 510-224-6484.

Circle No 603

ENCAPSULATED CELLS

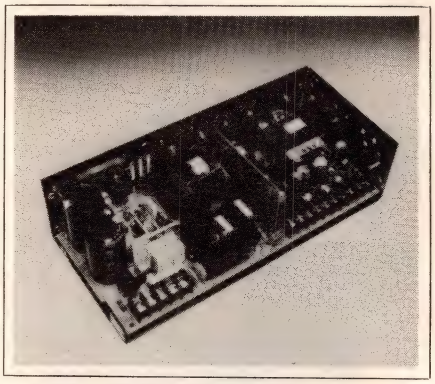
The Memoguard line of lithium manganese dioxide coin cells provides safety and reliability in temperatures ranging from −40 to +160°F. The batteries feature insulated cases with an automatic extinguisher that protects against fire; the housing also protects the cells from possible damage from chemicals. In addition, each cell combines resin encapsulation with cell sealing for hermetic encasement. At room temperature, the batteries' life expectancy exceeds 10 years.



The cells are enclosed in DIPs. Open circuit voltage is 3.5V, and nominal voltage—5-μA drain at 20°C—is 3.0V. Capacity at 3.0V nominal, 50 μA at 20°C is 200 mAhr, and maximum recommended drain at 20°C is 3 mA (to recover 75% of nominal capacity). $1 (OEM qty).

Saft America Inc, 107 Beaver Ct, Cockeysville, MD 21030. Phone (301) 666-3200.

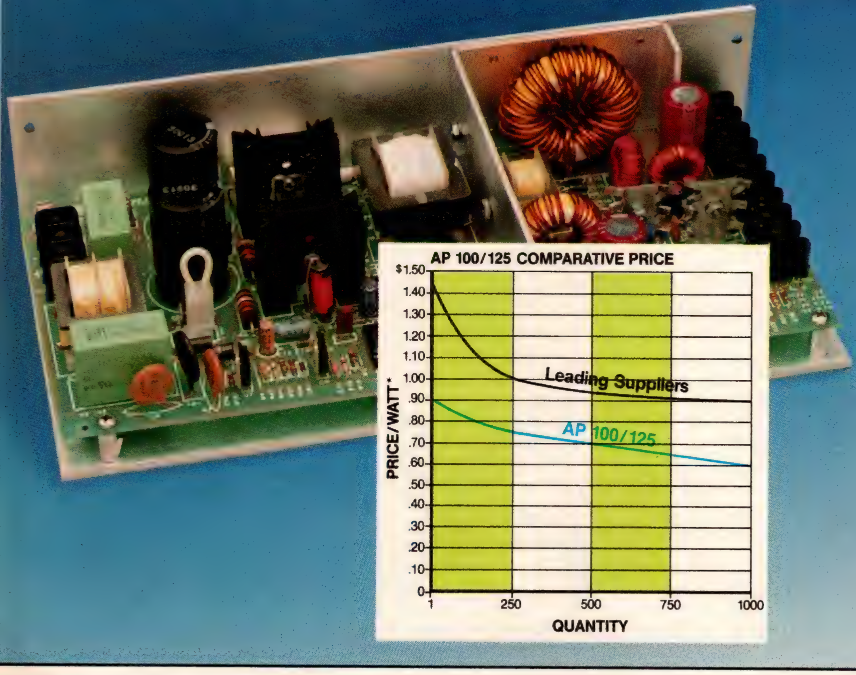
Circle No 595



5-OUTPUT SUPPLY

The HSS 180 switch-mode power supply has five outputs: three fully regulated and two semiregulated. Its continuous output rating is 180W with convection cooling, or 250W with forced air, as long as there is a 20-cfm minimum air-flow

First, we gave you 80% power supply efficiency.
Now, it's lower cost per watt.



The new AP 100 and 125 Switching Power Supplies are at least 25% lower in cost than competitive units on the market. Plus they have the same high efficiency we introduced with the AP 8151. Small quantity buyers get this same pricing advantage and unit costs continue to decline with larger volumes.

All AP switchers have over-voltage and short-circuit protection and meet the safety standards of UL, CSA, VDE, and IEC. They also satisfy FCC and VDE requirements for conductive and radiated noise without the need of additional shielding or filtering.

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10440 N. Tantau Avenue, Cupertino, CA 95014. (408) 255-9955.

* Subject to change without notice.

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The Ultimate in RF Power.

Solid State Reliability with Incredible Versatility.

500 Watts/A-500

- 300 kHz to 35 MHz
- Up to 1000 watts pulse and CW
- No bandswitching
- Works into any load impedance

3 Watts/603L

- 0.8 to 1000 MHz
- 3 watts of linear power
- Flat 37 dB gain
- Up to 5 watts saturated

25 Watts/525LA

- Flat 1 to 500 MHz
- 25 watts linear output
- Up to 40 watts pulse and CW
- No bandswitching

100 Watts/2100L

- 10 kHz to 12 MHz coverage
- 100 watts linear Class A power
- Up to 250 watts saturated

200 Watts/3200L

- 250 kHz to 150 MHz
- 200 watts linear power to 120 MHz
- 175 watts to 150 MHz
- Operates from 115/230V receptacle

400 Watts/1040L

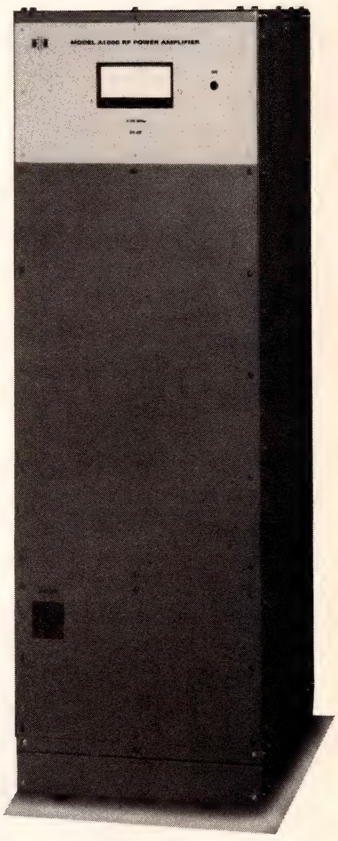
- 10 kHz to 500 kHz
- Up to 700 watts output
- Useful power up to 1 MHz
- Built-in true average power meter

100 Watts/5100L

- Flat 1.5 to 400 MHz
- 100 watts linear power
- 200 watts to 200 MHz
- No bandswitching

1000 Watts/A1000

- 300 kHz to 35 MHz
- 1000 watts linear Class A
- Ruggedly built
- Operates from 230 VAC, 3 phase



40 Watts/440LA

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New, low-cost, compact, lightweight high voltage power supplies

WG Series features constant voltage/constant current, plus off-line switching for low internal dissipation, high reliability

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- 5¼" panel height, weight 30 lbs.
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- Active mode indicators for voltage and current.
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- Primary contactor — additional safety feature, prevents self-turn-on after power outage.
- Low-stored energy for maximum personnel/equipment safety.

Innovations in high voltage power supply technology.

GLASSMAN HIGH VOLTAGE INC.
Route #22 (East), Salem Park, P.O. Box 551, Whitehouse Station, N.J. 08889
(201) 534-9007 • TWX 710-480-2839

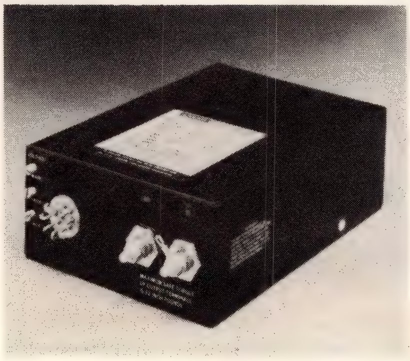
CIRCLE NO 85

rate. It also has a surge capability of 300W under certain conditions. A standard unit measures 9.8×4.56×2.6 in. and includes power-fail circuitry, a main terminal shroud, and a cover.

AC input voltage rating is 98 to 132V or 196 to 264V, 45 to 450 Hz. Inrush current-limiting circuitry confines input current peaks during switch-on to less than 40A under worst-case conditions (cold start only). The supply is overvoltage protected; a thermal cutout is optional. It meets national safety standards' certification and approval, including UL, CSA, and BS. $250 (100).

Bay Components Inc, Box 6638, Annapolis, MD 21401. Phone (301) 266-6767. TWX 510-600-7370.

Circle No 596



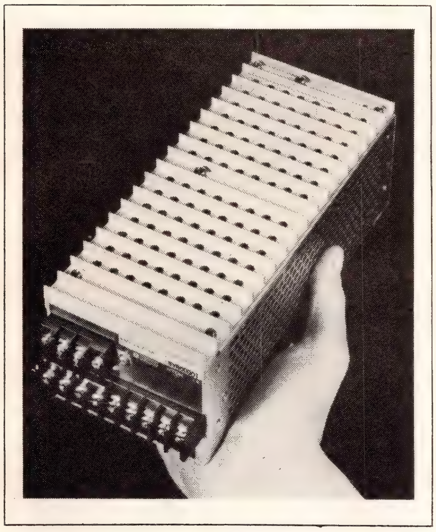
MILITARY SWITCHER

The Model M300T is a 300W, triple-output switching power supply enclosed in a 3×6×8-in. package. It can accept a 115V input at 47- to 440-Hz and deliver a 300W output at 5V (±12 or ±15V) for a 2.1W/in^3 density (per NAVMAT guidelines). EMI protection conforms to MIL-STD-461B, and input protection meets MIL-STD-1399. Hermetically sealed, the supply meets the environmental requirements of MIL-STD-810C as well as the 5-ft hammer drop of MIL-S-901C.

Ripple and noise are 100 mV p-p max, line and load regulation are 0.2%, and holdup time is 10 msec. Options include special connectors; 3-phase input; protection against severe shock, acceleration, and vibration; wider input-voltage range; and wider operating temperature range. $2450. Delivery, 14 weeks ARO.

Abbott Transistor Laboratories, Power Supply Div, 5200 W Jefferson Blvd, Los Angeles, CA 90016. Phone (213) 936-8185.

Circle No 597



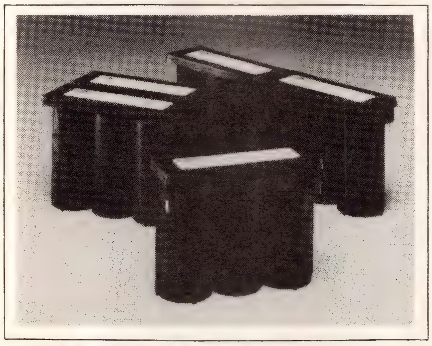
DC/DC CONVERTERS

The ERD Series operates at a switching frequency of 300 kHz, features an MTBF of 249,700 hours, and provides an efficiency of 82%. The converters come in 30, 60, and 150W models with single outputs of 5, 12, 15, 24, and 48V; a 24 and 48V input version of each model is also available. Power density is 1.51W/in^3, and weight is 0.016 lbs/W. The converters feature adjustable voltage outputs: −20 to +10% of nominal for 5 and 15V models, −30 to +10% for all others.

Remote error sensing and an isolated, TTL-compatible on/off signal are standard on all versions. A built-in EMI filter meets conducted-noise standards for MIL-STD-461B. In addition, the converters meet UL and CSA safety standards. 30W model, $135; 60W unit, $160; 150W version, $225.

Kepco Inc, 131-138 Sanford Ave, Flushing, NY 11352. Phone (718) 461-7000.

Circle No 599



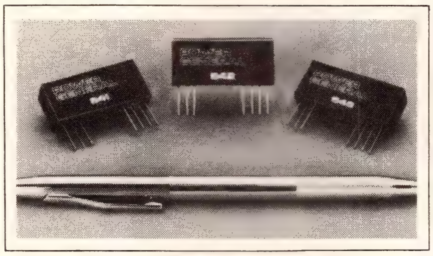
SEALED BATTERY

The E cell, a member of the Monobloc family, is an 8.0-Ahr rechargeable battery. It's a little taller than its sibling, the 5.0-Ahr X cell, but it has the same footprint, so designers can specify either 5.0- or 8.0-Ahr capacity in the same space.

The cell features a sealed design, incorporating spirally wound positive and negative plates using pure lead grids; this design recombines the gases in the battery within a starved electrolyte system. In addition, the cell is impervious to water loss and acid leakage. It has a float-charge life of 8 to 10 years at 23°C and a cycle life of 200 to 2000 cycles. You can operate, store, and charge the battery safely no matter what position it's in. A self-resealing safety valve will release pressure under abusive overcharge conditions. $10.30 (1000).

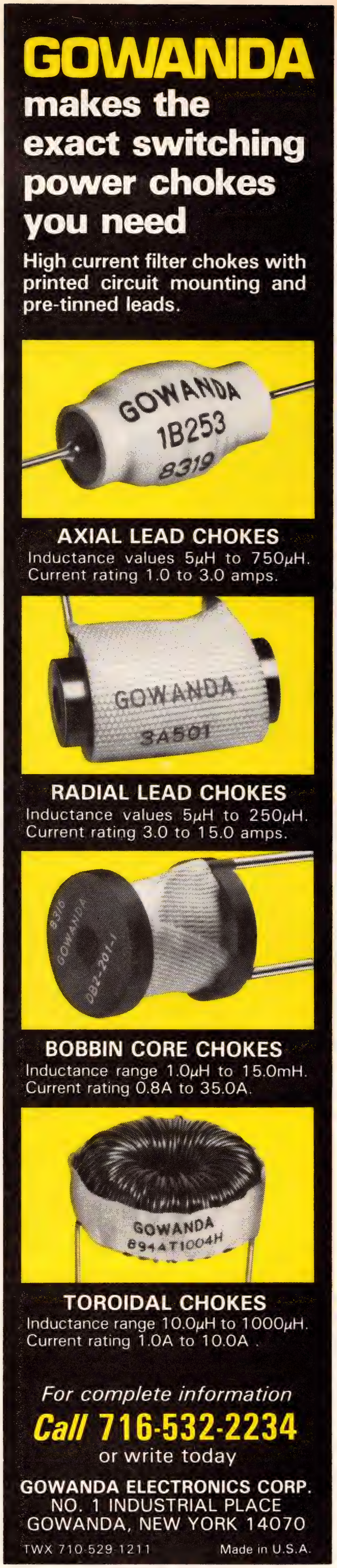
Gates Energy Products Inc, Box 5887, Denver, CO 80217. Phone (303) 744-4806. TLX 45511.

Circle No 600



DC/DC CONVERTERS

The 540 Series miniature dc/dc converters require 0.413^{2}in. of board space and reside in encapsulated SIPs measuring 1.25×0.55×0.33 in. You can mount them vertically or horizontally. The series includes six



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  - Digital 14
  - Power and Thermistors 15
- Microprocessor Development and Analysis 16
- PROM Programmers 19
- Oscillators 20
- Oscilloscopes 20
- D C Power Supplies 22
- Printers 22
- Probes 23
- Recorders
  - Digital Printing/Plotters 24
  - Event 24
  - Magnetic Tape 25
  - Oscillographic 25
  - Strip Chart 26
  - Temperature 26
  - X-Y 26
- Sources 26
- Synthesizers 27
- Telecommunications 27
- Terminals
  - Data 29
  - Graphics 30
- Test Bridges 30
- Test Chambers 31
- Test Sets 31
- Index 31
- Terms and Conditions .... Inside Back Cover

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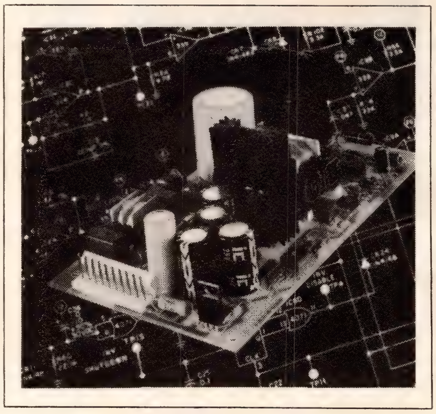
CIRCLE NO 163

models, which operate from power bus levels of 5 or 12V dc inputs and provide outputs of 5, 12, or 15V dc. The 1W converters also offer 300V I/O isolation, 100-mV p-p ripple and noise, thermal-overload protection, and foldback short-circuit protection. The operating temperature range spans −25 to +70°C.

The converters operate at a 45 to 55% efficiency. Line regulation is 0.5% for a low- to high-line change, and load regulation is 1% for a 0 to 100% load change. $36.50 each.

Power General, Box 189, Canton, MA 02021. Phone (617) 828-6216. TWX 710-348-0200.

Circle No 606



50W SWITCHERS

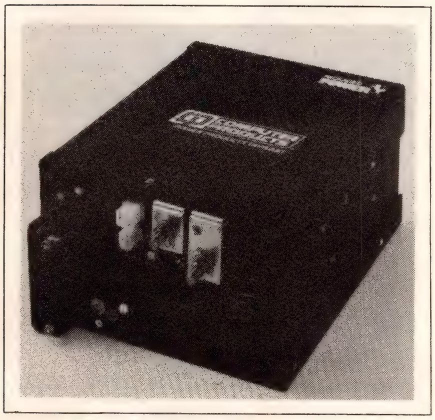
These 50W, single-output switchers have an MTBF calculated at 50,000 hours at full load for 25°C ambient temperatures. The switchers undergo hipot testing at 1500V ac for one minute at both input to output and input to ground, and they experience 100% burn-in for 24 hours. UL recognized and CSA listed, the switchers meet IEC and CEE safety requirements and have a typical efficiency of 70%. Features include built-in EMI filtering, short-circuit protection for all outputs, low-output ripple, and overvoltage protection for the 5V output. Holdup time is 15 msec at full load, and inrush current is 16A at 115V ac at 25°C ambient (cold start).

The switchers accept input voltages of 90 to 132V ac and operate on an ac input current of 1.0A rms at

115V ac. You can choose from four models having voltage ratings of 5, 12, 15, or 24V; all models feature open-frame construction. From $85.

Sola, 1717 Busse Rd, Elk Grove Village, IL 60007. Phone (312) 228-1393. TLX 280538.

Circle No 602



500W SWITCHERS

This line of 500W switchers comes in single-, dual-, triple-, and quad-output configurations. Single-output models offer outputs of 2V at 160A, 5V at 100A, 12V at 42A, 15V at 33A, 24V at 21A, 28V at 18A, and 48V at 10A. For these models, current sharing is standard. Multiple-output models have their main 5V output rated at 60A; auxiliary outputs offer the following voltage and current ratings: 2V at 10, 5, or 3A; 5V at 10, 5, or 3A; 12V at 10, 5, or 3A; 15V at 10, 5, or 3A; 24V at 6, 5, or 3A; 28V at 6, 5, or 3A. These models include current sharing to provide parallel operation only on their main output.

The series complies with such safety and EMI standards as VDE, IEC, FCC, UL, and CSA. All units offer remote inhibit, remote voltage adjusting of the main output, remote sensing on all outputs, ac power-fail detection, overvoltage protection, and voltage out-of-tolerance detection on the main output. Line and load regulation are 0.2%, hold-up time is 30 msec, and output ripple is 1% or 50 mV p-p. Inputs of 90 to 132V ac or 180 to 264V ac are field selectable. The switchers are housed in cases measuring 5×8×10 in. and have a typical efficiency of 70 to 75%. Prices range from $600 for single-output models to $750 for quad-output versions. Delivery, six to eight weeks ARO.

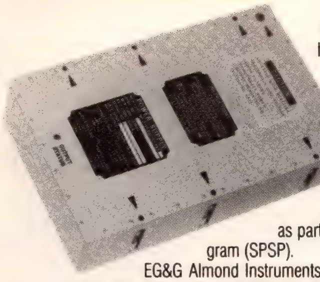
Computer Products Inc, Power Conversion Group, 2981 Gateway Dr, Pompano Beach, FL 33069. Phone (305) 974-2442. TWX 510-956-3098.

Circle No 601

DC/DC CONVERTERS

These three dc/dc converters, the 24S12.1000, the 24S15.800, and the 24S5.2000, are designed for use with 24V batteries in telecommunications applications. All are single-output units that have a 3:1 input range; each can accept any voltage

NAVY STANDARD POWER SUPPLIES



Navy Standard Power Supplies are now being mandated on Navy contracts. All Navy Standard Power Supplies meet general NAVSEA Specification SE 010-AA-SPN-010, and appended slash sheets identify individual model characteristics. EG&G Almond Instruments' Slash Sheet power supplies are being qualified by the Naval Weapons Support Center (NWSC), Crane, Indiana as part of the Navy Standard Power Supply Program (SPSP).

EG&G Almond Instruments has submitted Slash Sheet 7 (150 Watt, 3 Output) and Slash Sheet 8 (300 Watt, 3 Output) SPSP models to NWSC for qualification. Our Slash Sheet 1 (750 Watt, 2 Output) SPSP unit was submitted in April 1986.

The units are housed in SPSP 2.48″ x 6.8″ x 10.8″ chassis designed for coldplate cooling. They have a minimum calculated MTBF of 100,000 hours (per MIL-HDBK-217D) for a Naval Sheltered environment at 50°C baseplate temperature.

The Slash Sheet 1, 7, and 8 units accept inputs of 115VAC; 60Hz, 3 phase delta (DoD-STD-1399, Sec. 300) and 155VDC. Slash Sheet 1 outputs, 5VDC @ 80A and 5VDC @ 70A, can be paralleled. Slash Sheet 7 and 8 SPSP's have three outputs, 5VDC @ 25A, ± 15VDC @2A, and 5VDC @ 50A, ± 15VDC @ 2A, respectively.

Remote on/off, voltage programming, remote sense, output status and over-temperature, over-voltage, and over-current shutdown are provided. Environmental Stress Screening (ESS) is performed on all SPSP power supplies.

Consult EG&G Almond Instruments for information on other SPSP power supplies, additional output configurations and different chassis styles.

EG&G ALMOND INSTRUMENTS

EG&G Almond Instruments, 1330 E. Cypress Street, Covina, California 91724 (818) 967-9521.

CIRCLE NO 202

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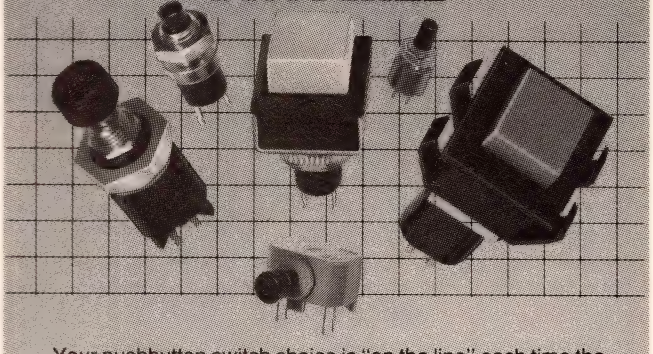

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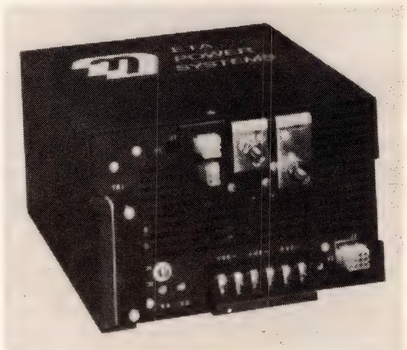
Power Sources

from 12 to 36V dc. Model 24S12.1000 has a 12V output at 1A; Model 24S15.800 provides a 15V output at 800 mA; and Model 24S5.2000 generates a 5V output at 2A. The 5V model includes overvoltage protection.

All three converters have input filters and are enclosed in 6-sided shielded cases measuring 3.5×2.5×0.875 in. All outputs are isolated (500V dc) and short-circuit protected. Regulation is 0.02%, noise is 10 mV p-p, and minimum efficiency is 70%. From $118.

Calex Mfg Co Inc, 3355 Vincent Rd, Pleasant Hill, CA 94523. Phone (415) 932-3911. TLX 338506.
Circle No 604



SUPPLIES

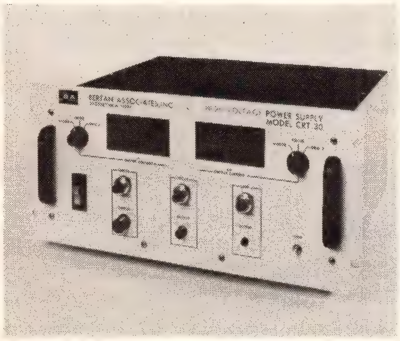
Enclosed in 5×8×10-in. packages, these six supplies boast a packaging density of 3W/in^3. They deliver outputs varying from 50 to 1200W at 50°C; output voltages of 2 to 48V dc are available for each model. Single-output units have maximum output levels of 500, 800, 1000, and 1200W;

two multioutput units have ratings of 500 and 700W and as many as four outputs each. The 500W, multioutput model delivers 60A max from its main output and a maximum of 10, 5, and 3A from its auxiliaries. The 700W multioutput unit generates 100A from its main output and 10, 7, and 5A from its auxiliary outputs. Single-output units demonstrate a 65,000-hour MTBF; multioutput supplies demonstrate an MTBF of 55,000 hours.

You can select an input range of 90 to 132V ac or 180 to 264V ac. Line and load regulation are 0.2%; minimum holdup time is 30 msec. Other features include overvoltage protection; current limiting; no-load, thermal, and reverse-voltage protection; remote sensing; and ±10% voltage adjustment. 1200W unit, $893 (50). Delivery, 6 to 12 weeks ARO (OEM qty).

ETA Power Systems Inc, 2675 Junipero Ave, Signal Hill, CA 90806. Phone (213) 427-0095.

Circle No 605



CRT-TEST SUPPLIES

These 3-output, high-voltage power supplies, the CRT-30 and CRT-50, are useful for testing CRT displays. You can independently control and monitor the three outputs from the front panel or with remote-programming controls. Precision multiturn potentiometers and digital displays provide output control and monitoring. Digital programming is available in either 16-bit binary or 4-decade BCD TTL-compatible formats; a separate IEEE-488 interface is also available.

The CRT-30 and CRT-50 deliver anode voltages of 30 and 50 kV at 2 mA respectively, a focus of 10 kV, and a G2 voltage of 1 kV. All three outputs are short-circuit and arc protected. Options include filament and G1 outputs and dynamic focus. Both units provide highly regulated outputs—0.01% line and load regulation—and low ripple—0.01% p-p. The supplies are housed in 19-in. rack-mountable enclosures that measure 8¾×15 in. CRT-30, $3090; CRT-50, $3650.

Bertan Associates Inc, 121 New South Rd, Hicksville, NY 11801. Phone (516) 433-3110. TXW 510-221-2144.

Circle No 608

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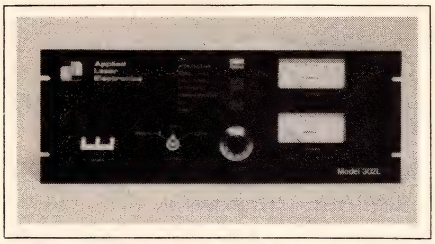


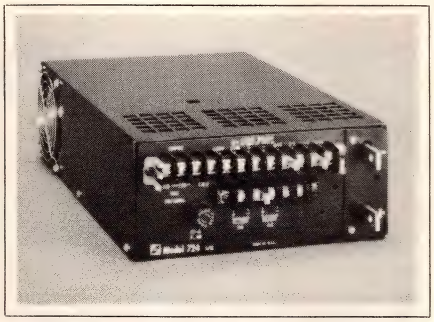
CAPACITOR CHARGER

The 302L high-voltage power supply suits use in lasers and pulsed-power research. This capacitor-charging supply is available in eight output voltage ranges—from 1 to 40 kV—and with output power as high as 4000J/sec. Requiring 7 in. of rack space, this supply can charge a capacitor bank at rates exceeding 100 Hz. It is also protected against short circuits.

The supply uses air cooling and is prewired for both single-phase and 3-phase input power, 50 to 60 Hz, so that you can select power input on site with no adjustments. The front panel has a lockable switch, which permits you to select remote or local operation. You can parallel the supply in configurations of as many as 10 units for higher output. $6825.

ALE Systems Inc, Ashland Technology Ctr, 150 Homer Ave, Ashland, MA 01721. Phone (617) 881-5252.

Circle No 607



QUAD SWITCHER

This company's Series 700 now has a 550W, 4-output switcher, Model 724. The switcher uses a magnetic-reactor regulator in both the primary and secondary circuits to achieve high efficiencies on all outputs. Housed in a 3.34×8×13.5-in. package, it delivers 5V at 50A (plus auxiliary outputs adjustable from ±12 to ±15V at 6A) and 24V at 4A with a 6A surge capability for disk drives. You can select a 115 or 220V ac input at the unit's barrier strip. All outputs have current limiting and short-circuit protection. Overvoltage protection is standard on the 5V and ±12 to ±15V outputs; remote sensing is standard on the 5V output only. $750.

RO Associates Inc, Box 61419, Sunnyvale, CA 94088. Phone (408) 744-1450. TWX 910-339-9304.

Circle No 611

RUGGED BATTERY

This lithium thionyl chloride battery is available in three sizes. Cell designation and size are TL-5526, C size; TL-5551, D size; TL-5576, DD

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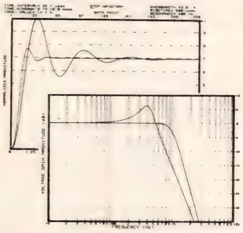

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size. All three sizes have a rated voltage of 3.4V, are hermetically sealed, and have a shelf life of 10 to 15 years for the −40 to +70°C range. Model TL-5526 has a rated capacity at 150°C of 4.5 Ahr and a maximum continuous current of 40 mA; Model TL-5551 has a 10-Ahr capacity and 60-mA current; and Model TL-5576 has a 22-Ahr capacity and 100-mA current. Prices start at less than $30 (OEM qty).

Tadiran Electronic Industries Inc, 40 Seaview Blvd, Port Washington, NY 11050. Phone (516) 621-4980. TLX 6973370.

Circle No 613

CONVERTER

The E700 VF dc/dc and dc/ac converter is designed for vacuum-fluorescent (VF) display applications requiring 3W total. It provides the two outputs that are required by most VF displays—the dc anode and the ac filament. You can tailor both outputs to your display. The converter is 1.1×1.2×0.91 in. and is suitable for Noritake, Futaba, and NEC displays. Prices range from $13.26 to $20.81 (100).

Endicott Research Group Inc, Box 269, Endicott, NY 13760. Phone (607) 754-9187. TWX 510-252-0155.

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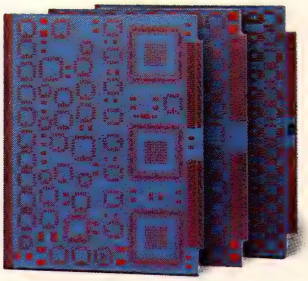

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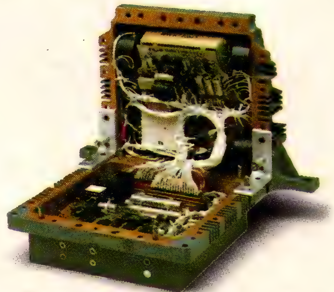

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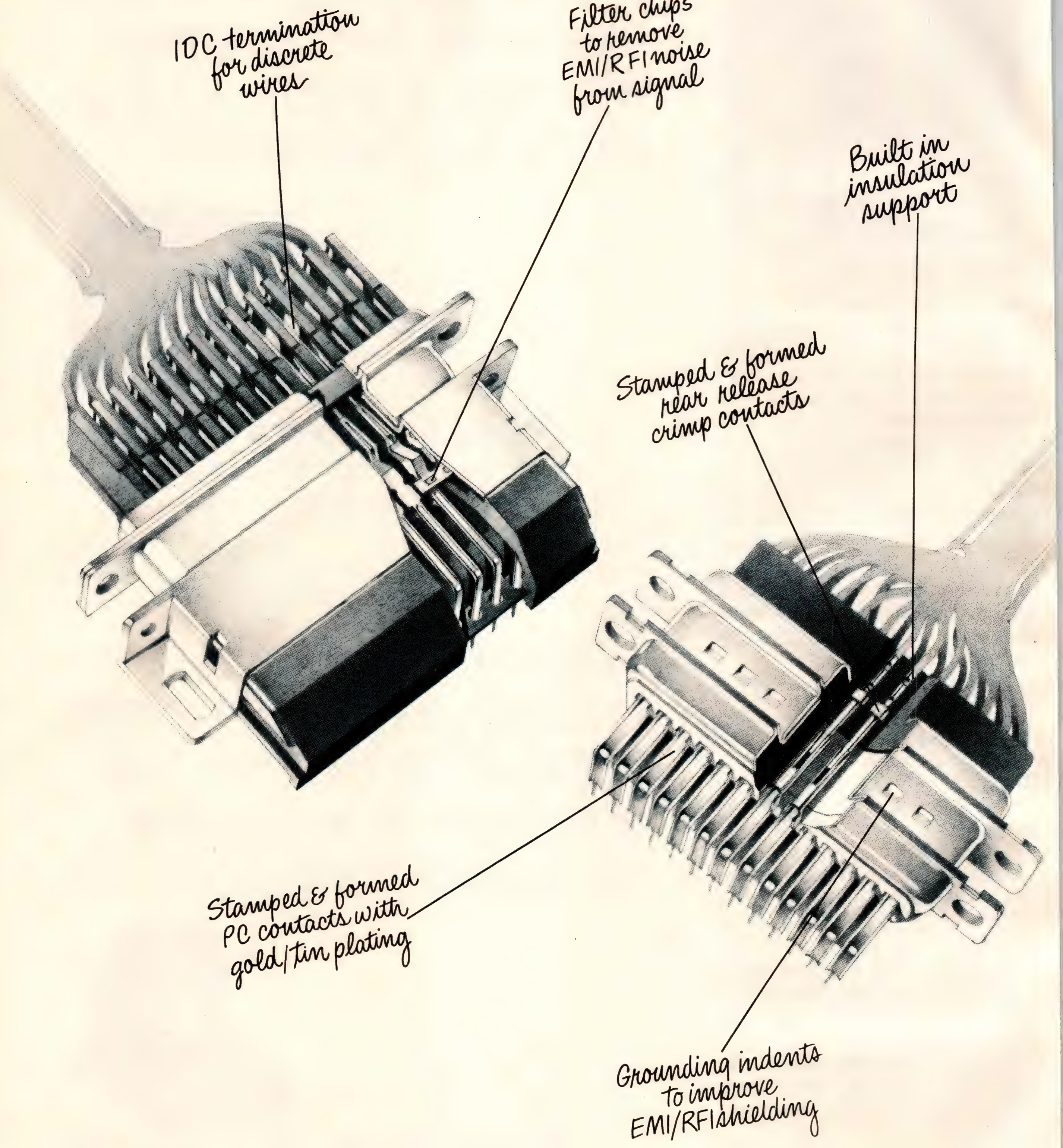
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lified: D Subminiature termination.

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Let Amphenol D-Subminiature connectors help you put an end to termination problems and high assembly costs.

Our new rear-release model, for example, features economical stamped and formed crimp contacts that are ideal for high-speed automatic termination. For increased reliability, these contacts include an integral insulation support. And to minimize loading errors, each contact position in the insert has a highly visible white number.

Other Amphenol D-Subminiature models provide cost effective IDC termination with either planar cable or discrete wires. For increased reliability, the discrete wire IDC design features integral insulation supports. The planar IDC features built-in strain relief.

EMI/RFI control is another problem that's easily and economically solved with Amphenol D-Subminiatures.

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CIRCLE NO 180

Backplanes play a crucial role in high-speed systems

The backplane is no longer simply a mounting surface for daughter boards; instead, it's an important component in a sophisticated connection system. Because of the fast switching speeds and high circuit densities prevalent in today's applications, the backplane you select seriously affects your system's electrical performance.

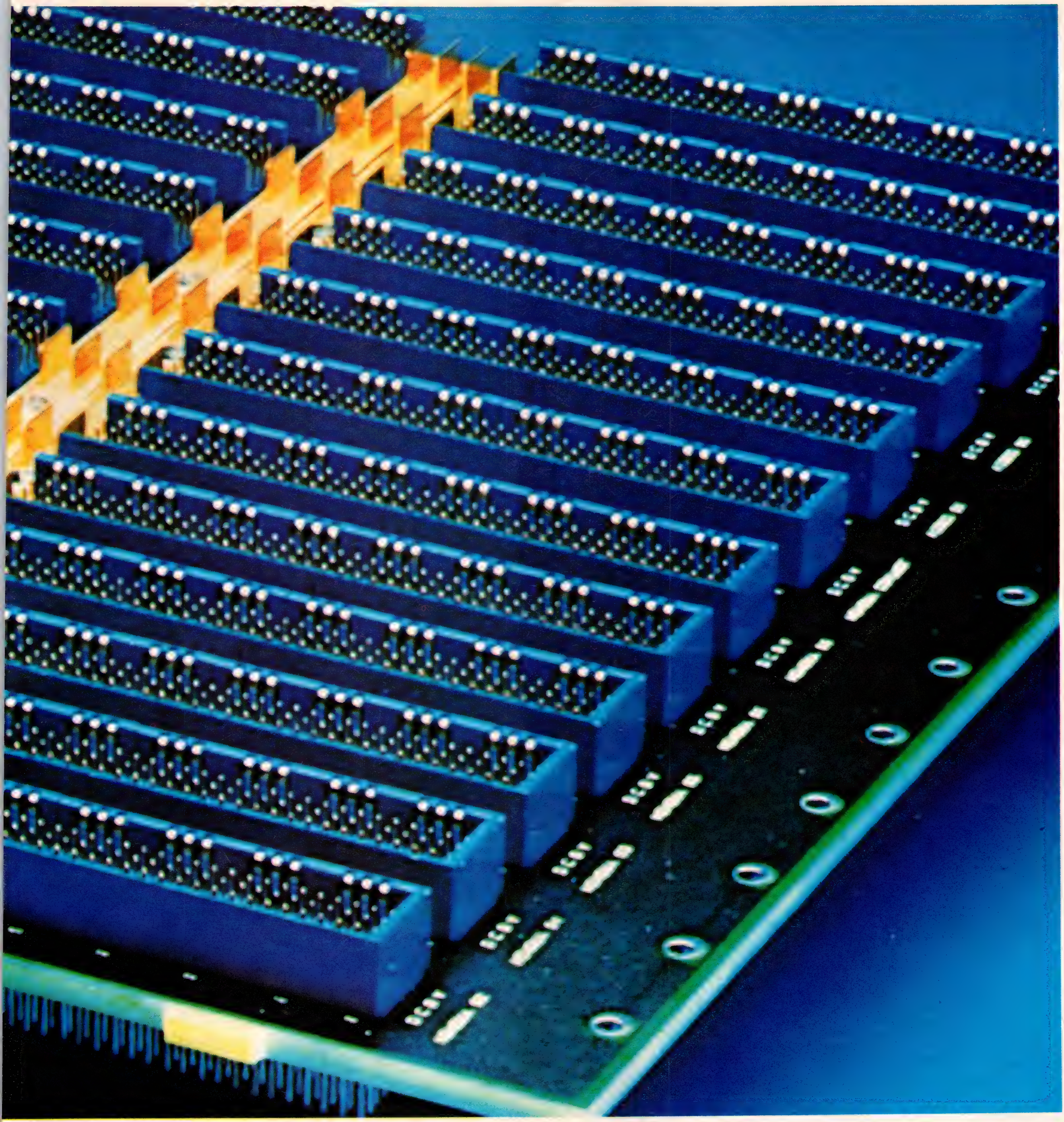
Tom Ormond, *Senior Editor*

When you're specifying a backplane for your high-speed system, remember that the backplane adds as much electronic value to overall system performance as it does mechanical value. Faster switching speeds, increasing circuit density, and device complexities place critical electrical demands on the backplane system, so you need to specify one that can accommodate these idiosyncracies of high-speed logic systems.

A backplane isn't simply a piece of metal at the rear of a card cage; it's a component in a complicated interconnection system. In a high-speed system, the transmission lines (contacts, printed circuit traces, etc) on the backplane must closely match those in the immediate environment. Further, to maximize the performance of these high-speed logic systems, the interconnection lengths must be as short as possible.

As the system's switching speeds increase, the interconnection system must control such characteristics as electrical noise, characteristic impedances, power distribution, and signal integrity. The backplane must also provide low-inductance grounding. Grounding affects interconnection capacitance, inductance, and transmission-line properties. In fast-switching digital systems, it's absolutely crucial for you to choose a backplane that provides adequate nearby ground returns for controlling crosstalk and reflections, and that maintains switching speeds and signal integrity in all circuit interconnections.

Today's backplanes are essentially transmission lines, and as such they have characteristic impedance. When



High-density backplane *(Teradyne Connection Systems Inc)*

a transmission line operates into a load mismatch, reflections develop. The higher the characteristic impedance/load mismatch, the worse the reflections. Reflections translate into noise, so it's important to keep your system load as closely matched as possible to the backplane's characteristic impedance. Further, note that as you start to load the backplane, you're going to lower its characteristic impedance. You must take this change into consideration when you're matching your system load to the backplane's impedance.

Crosstalk, resulting from capacitive and electromagnetic coupling between traces on the backplane, is a second factor that can seriously affect your system's performance. Backplane manufacturers address this problem by optimizing the geometry of the traces, ground plane, and dielectric, thus effectively minimizing the physical side-to-side capacitance of the lines. Ground-plane guarding also tends to reduce the effective capacitance. In addition, the optimization technique reduces electromagnetic coupling, because eddy currents in the ground planes tend to separate and dissipate the fields.

Finally, you also need to consider power distribution when choosing a backplane. Proper power distribution

In today's high-speed logic designs, the backplane contributes as much electronic value to system performance as it does mechanical value.

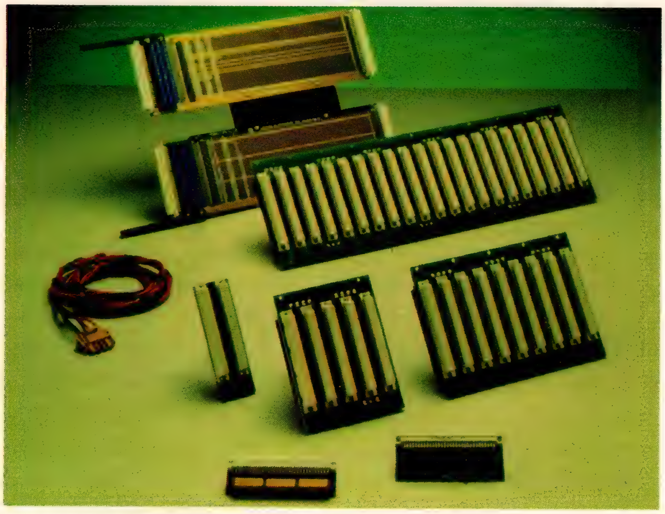
is a key element in a backplane's performance and reliability, but designers often overlook certain aspects of the power-distribution problem. For example, before you choose a backplane, you should map your system's current flows. If you can't obtain known consumption figures, use equal worst-case currents for each. You can then work with the backplane vendor to place power inputs and returns. Proper placement of inputs and returns will ensure that current densities will be uniform and that voltage drops will be low enough to permit reliable operation.

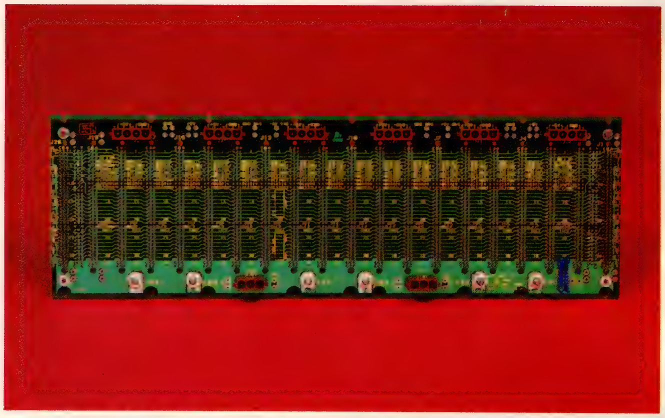
Remember that paralleling connector pins at power-entry points requires a significant derating of the pins' current-carrying capability. Any small difference in contact resistance will significantly unbalance the current flows.

When you look for a backplane, you'll find they come in two basic types: general-purpose, or uncommitted, backplane systems, and backplane systems designed for use in specific applications.

Among the uncommitted systems are Methode's Reli-Aplane connectors and backplanes, which combine to form a versatile interconnect system. The company offers fast-delivery prototypes, small-quantity preproduction units designed to accommodate modifications or changes, and large-quantity full production runs. The Reli-Aplane products let you design a complete backplane system by choosing from a variety of connector options.

The connectors consist of precision stamped contacts which are press-fit mounted directly into plated-through holes in an epoxy fiber-glass laminate panel. The manufacturer mounts press-fit insulator housings onto the contacts, forming a finished connector. The backplanes are available in configurations that employ cantilever-edge connectors, bellows-edge connectors, NAFI/SEMS MIL-C28859 fork-and-blade connectors, or inverse shrouded and unshrouded male pliant pins.


VME Bus backplane *(Vector Electronic Co)*


VME Bus backplane *(Hybricon Corp)*

The backplane system can connect as many as 10 levels of circuitry. To connect the levels, the manufacturer sandwiches dielectric insulator sheets between discrete double-sided pc boards with plated-through holes. The gas-tight interface between the press-fit contacts and plated-through holes provides layer-to-layer interconnections, and it also securely holds the sandwiched boards together.

Methode also offers the Reli-Aplane hybrid backplane system, which employs a variation of the standard multilevel construction. In the hybrid, solid metal plates are sandwiched between double-sided pc boards or plain unclad FR4 boards. Pure copper plates offer low resistance and high current capability in power and ground planes. Low-carbon iron plates offer EMI shielding and protection for signal planes and EMI-sensitive components.

The Reli-Aplane system is also available in multilayer, impedance-controlled configurations with as many as 22 layers. The manufacturer tests each backplane before shipping it.

Another general-purpose backplane system is Teradyne's High Density Plus, a complete modular system that's designed for use in LSI- and VLSI-based product designs. The manufacturer offers backplanes as large as 27×27 in. and having as many as 16 layers. You can also obtain backplanes that have ±10% characteristic-impedance control and offer circuit traces and spaces as close as 0.006 in.

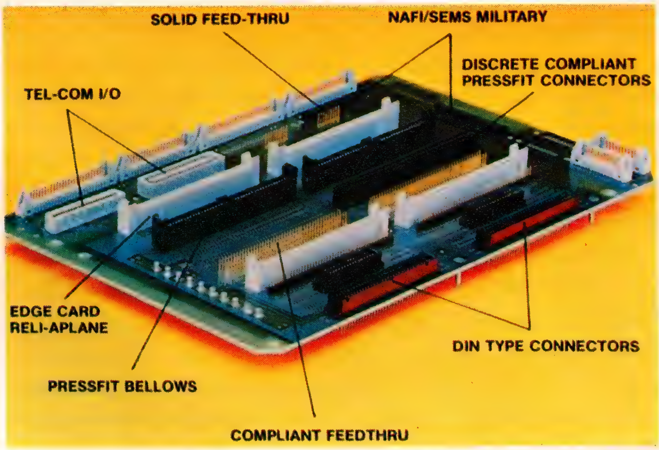
The modular construction of the High Density Plus backplane and daughter-board connectors gives you flexibility in designing a custom backplane interconnection system. Each module contains either 60 or 80 signal contacts in a high-density, 4-row, 0.1×0.1-in. grid configuration. Female contacts located in the daughter-board modules provide high normal force between mating contacts. The dynamic retention, press-fit feed-through contacts, which are positioned on the backplane, permit easy replacement in the field. The contacts are coined and polished smooth in the mating areas to minimize engagement forces.

You can arrange the backplane and daughter-board connector modules end-to-end in any combination to achieve the interconnection pattern you want. Further, you can place the connectors' rows on very tight centers to maximize both interconnect density and the use of backplane space.

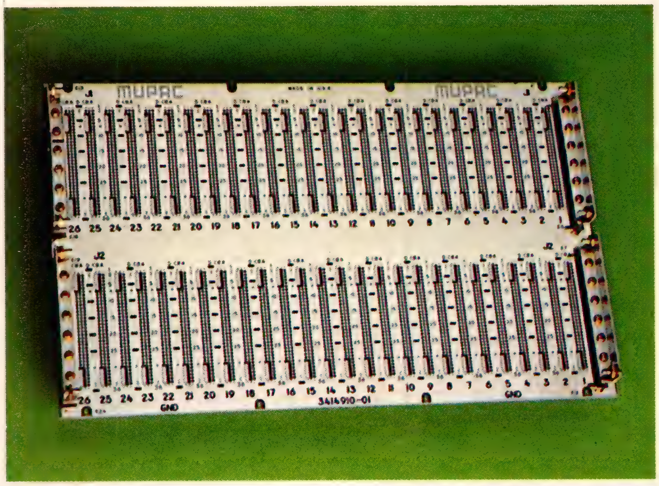
The connectors provide 85g min normal force. The High Density Plus system, which includes eight standard bus-bar configurations and power contact arrays rated at 15A, is designed to handle the power-distribution needs of the high-speed devices found in ECL, Schottky TTL, and CMOS gate and standard-cell arrays.

Pricing for the complete High Density Plus interconnection system depends on configuration, complexity, and quantity. The backplanes start at approximately $0.12 per mated contact pair. The manufacturer tests all parts before shipping.

A high-speed, high-power backplane from Mupac, the 3414910-01, features multilayer construction and is designed to interface with the company's family of card cages for vertically mounting multilayer Schottky-compatible panels. Priced at $450, the backplane is engineered to equalize current flow throughout the power-bus system. It can handle the rise and fall times associated with high-speed logic devices.



General-purpose backplane (Methode Electronics Inc)



Power backplane (Mupac Corp)

Offering a 26-position, dual-connector capacity, this 4-layer panel employs 2-oz copper for all layers, and has three potential levels—V_1, V_2, and ground. Plated-through holes couple voltage and ground planes together, thereby equalizing current flow throughout the power-bus system. The panel can carry a maximum current of 300A.

The backplane's design includes dedicated V_{CC} and ground connector pins, but you can easily commit additional pins to the ground plane by using solder washers. A #10 tin-plated bronze stud provides access to the backplane's power system. The power lugs are press-fit types. The backplanes also provide holes for decoupling capacitors. Featuring low characteristic impedance for maximum noise immunity, the backplanes come with standard connector spacings of 1.2 in., but 0.6-in. spacings are available as an option.

Besides buying uncommitted backplane systems, you can also find backplanes designed for specific applications. For example, you can obtain backplanes designed for VME/VMX Bus applications from such vendors as Hybricon, Vector, and Augat. Hybricon offers two VME Bus backplanes. The J1, which accommodates as many as 21 boards, processes data at transfer rates as high as 40M bytes/sec. The J2, which is designed for the VMX Bus, supports 32-bit processors operating at the same data rate.

The J1 backplanes feature multilayer, rigid laminated construction and have full ground and power

In high-speed applications, interconnects should be as short as possible to minimize delays and related inductance/capacitance problems.

planes, which minimize signal interference. The backplanes have DIN 41612 connectors that are specified at quality level 2 for 400 insertions. Their connectors are pliant, press-fit types. The backplane's power studs provide safe fusing margins at power and ground-plane interfaces.

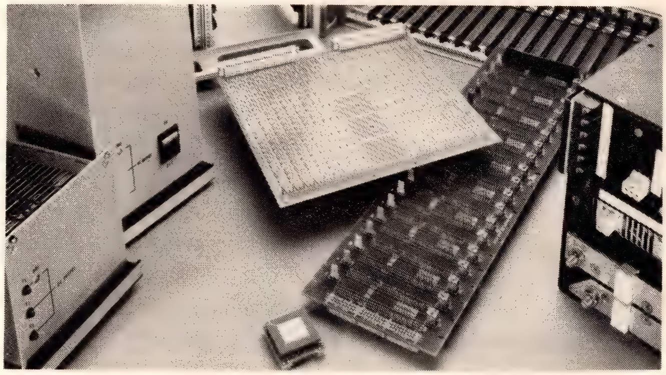
The J1 backplane carries three signal layers, a full ground plane, and a full power plane. Its optimized line-width/ground-plane spacing ratio and 5-layer construction reduce crosstalk, noise, and capacitive loading on the bus lines.

In the 4-, 5-, 6-, 9- 10-, 11-, 12-, 20-, and 21-slot standard backplane versions, the pliant, press-fit connectors are spaced at 0.8 in. Daisy-chain signals are not terminated on the backplane. Instead, according to the VME specification, the backplane uses removable shorting jumpers to propagate Bus Grant and Jack signals through unoccupied slots. Resistive terminations are installed between the last two signal buses at each end of the backplane. These thin-film networks come in SIPs and meet all VME specifications. You can easily remove them to couple backplanes side by side. Decoupling capacitors at the terminations preserve signal integrity and prevent crosstalk.

The backplanes feature positive, high-current power-access connections that exceed standard VME specifications. Standard J1 backplanes provide power (5V) and ground access through both Amp (Harrisburg, PA) Mate-n-Lok connectors and No 10 screw terminals, which are rated for 50A. Fast-On connectors from Amp and Power-Bug connectors from Winchester (Waterbury, CT) are available as options.

Hybricon also offers three J2 backplanes: a general-purpose device; a device that allows convenient user I/O and special connections; and a device that's preconfigured for the VMX Bus. In the basic expansion-bus version, the center row of pins on the 96-pin connector is connected for 32-bit expansion. The other two rows are left unterminated. The VMX Bus version has the same 32-bit expansion connections in the center row; connections for the VMX Bus are on the outer two rows of the connector.

Connectors on the J2 backplanes are spaced at 0.8 in. The VMX Bus model carries two signal layers, a full ground plane, and a full power plane. The I/O expansion model is double-sided, and has a full ground plane. Standard I/O expansion models are available in 4-, 5-, 6-, 9-, 10-, 11-, 12-, 15- 16-, 20-, and 21-slot versions. Standard VMX Bus backplanes come in 3-, 4-, 5-, and 6-slot versions, and the general-purpose designs are available in 4-, 5-, 6-, 9-, 10-, 11- 12-, 16-, 20 and 21-slot models.



VME Bus backplane *(Augat Inc)*

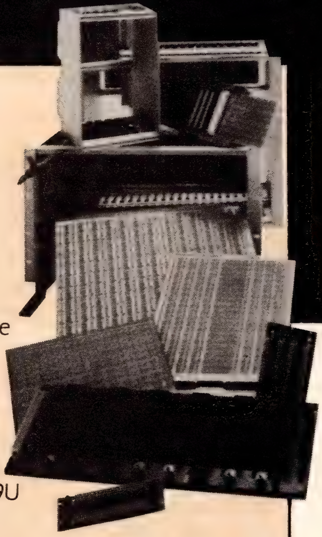
Another application-specific backplane comes from Vector. The company's VME Bus backplanes offer high speed, low noise, 6-layer construction and controlled-impedance design. The backplanes feature a patented shielding technique that prevents crosstalk problems, the company claims. The line offers two backplane designs. J1 units feature 6-layer construction and are available in 5-, 9-, and 21-slot versions. Two 2-oz power and two 2-oz ground planes provide efficient power distribution. The J2 panels are also available in 5-, 9-, and 21-slot versions. On these units, the B row of connector pins is preterminated to accommodate 32-bit expansion. The A and C connector rows are user definable, and are compatible with the VMX Bus.

All backplanes feature an off-board termination scheme that allows them to accommodate 21 connector slots while maintaining 0.8-in. slot spacing. The backplanes also feature polarized power connectors that disconnect quickly. The planes employ DIN 41612 female connectors.

Interconnect and terminator boards round out the backplane line. You can connect two or more backplanes without losing a slot, yet maintaining the 0.8-in. connector spacing. Like the backplanes, the boards feature a controlled-impedance design, which preserves the backplane's transmission characteristics.

By connecting power directly to the wire-wrapping pins on the DIN connector, you can use the interconnect board as a 2-slot backplane. The terminator boards terminate the bus lines as required by the VME specification. You can remove the terminator board and place it on an extender board to maintain proper termination during board testing.

The Express backplane system from Augat is de-



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In fast-switching systems, a backplane must provide adequate grounding in order to control crosstalk and reflections.

signed to meet VME and DIN specifications. The product line includes large prototyping panels that use surface-mount decoupling capacitors, high-performance backplanes, 100-kHz switching power supplies, extender boards, and adapters that accommodate surface-mountable components.

The J1/VH backplane employs 6-layer technology. Three large ground/power planes control impedance, minimize crosstalk, and limit RFI. The three signal layers reduce crosstalk by separating the bus signals. The backplane's characteristic impedance specs at 50Ω±10%. The backplane, which costs $576, readily accommodates 20-MHz system clock rates.

All but one of the backplane's connectors are normal pc-board-length, press-fit DIN types. The exception, a 96-pin DIN connector located in the last slot of the backplane, has 96 wire-wrappable pins protected by a shroud. Designers can use this connector as an interconnection point to an adjacent backplane or to a logic analyzer. A separate row of pins adjacent to this last connector accepts Bus Grant jumpers—small hand-insertable shunts. The manufacturer provides space on the J1/VH so you can augment a passive termination scheme by mounting resistors on the backplane. You deliver power to the backplane via traditional snap-on power lugs rated for 3 to 5A.

A second backplane from Augat, the J1/H, also features 6-layer construction. Only four of these layers —ground, power, and two signal layers—are functional, however. The outer two layers are used only to locate pads; however, they do provide some physical protection for the signal layers. Although its crosstalk performance is not as good as that of the J1/VH, the J1/H backplane offers the same impedance-control spec, ±10%, that the J1/VH offers.

The $476 J1/H backplane locates the Bus Busy signal (BBSY) on the B1 connector. BBSY is a control signal that's very susceptible to crosstalk; when this line is experiencing too much crosstalk, the system doesn't know when the bus is busy or available. The J1/H solves this crosstalk problem by routing the BBSY signal out and around the power lugs, isolating it from all other signals.

The backplane's 96-pin DIN connectors are selectively loaded with long pins in some of the B- and A-row positions normally used by the Bus Grant jumpers. The last connector has a shroud on all 96 of its wire-wrappable pins, and it permits you to extend the bus signals. This backplane also allows you to mount terminating resistors on board. For providing power to the backplane, you have the option of using screw-in power connectors or quick-connecting tab terminators.

If your system will use the newer high-speed 8-MHz processors available on the STD Bus, consider specifying the BP-300, -400, -500, and -600 (4-, 8-, 6-, and 12-slot backplanes, respectively) from RLC. These 2-sided, FR4 epoxy-glass pc-board backplanes have plated-through holes and solder masks on both sides.

The component side of each of these panels has a full ground plane. On each panel, the STD Bus interrupt-priority daisy chain is fully implemented. All of the backplanes—$89 to $129—feature onboard passive terminators (pull-up and pull-down) for all signal lines at the end of the bus. Connectors for all models are on 0.6-in. centers and feature gold contacts.

You can order each of the four backpanels already mounted in a heavy-duty, industrial-grade card cage. The cages are made of aluminum and feature anti-vibration, shock-dampening card guides, whose open design allows a free flow of air. Cages with backpanels are available in side- or rear-mounting styles and cost $139 to $189. **EDN**

For more information . . .

For more information on the high-speed backplanes discussed in this article, circle the appropriate numbers on the Information Retrieval Service card or contact the following manufacturers directly.

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Attleboro, MA 02703
(617) 222-2202
Circle No 521

Hybricon Corp
410 Great Rd
Littleton, MA 01460
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Mupac Corp
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RLC Enterprises
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Teradyne Connection Systems Inc
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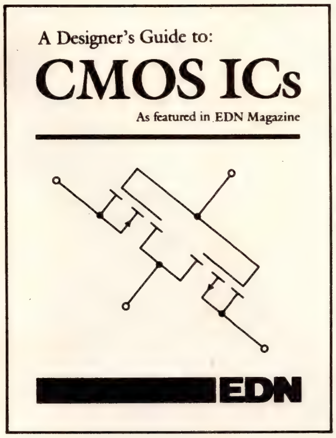
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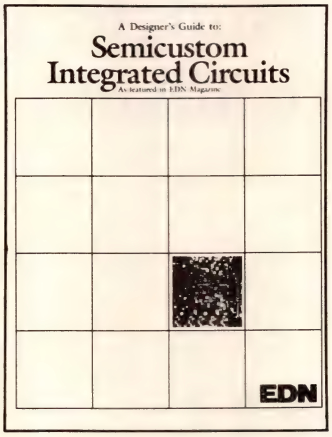
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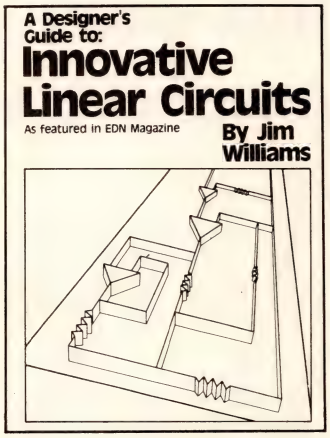
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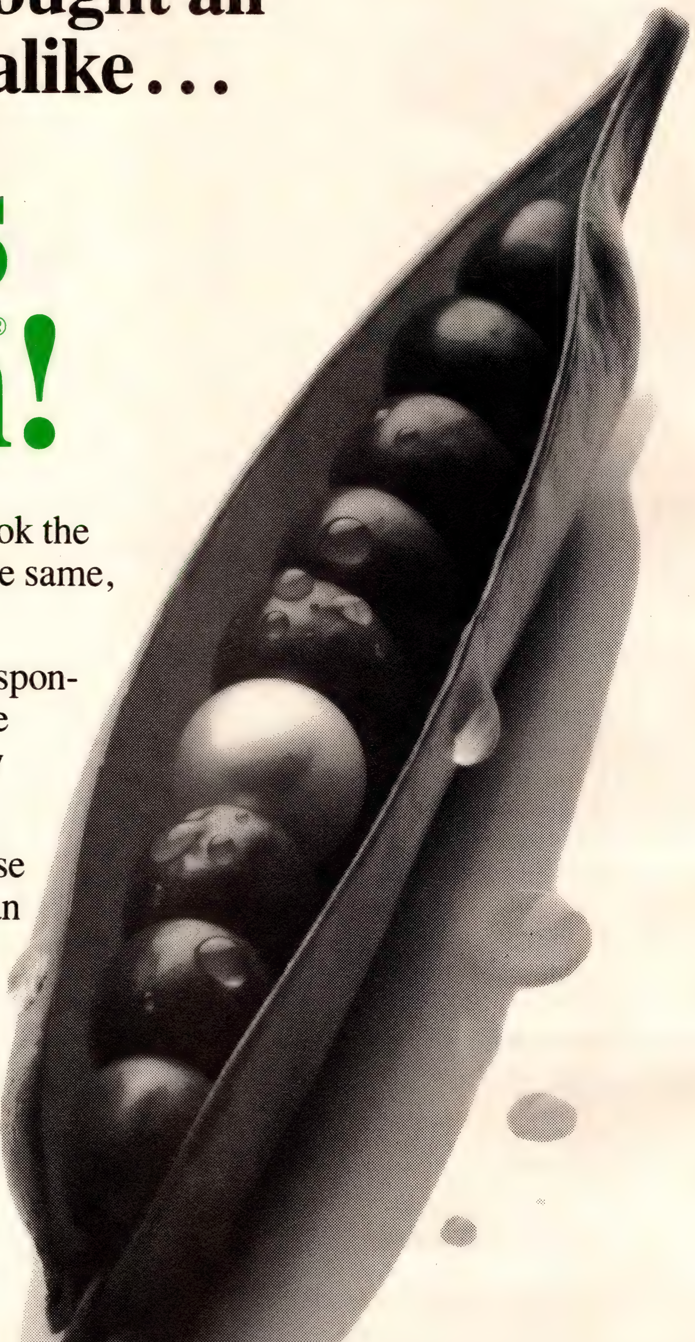

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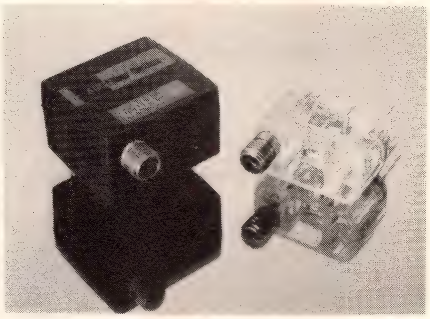


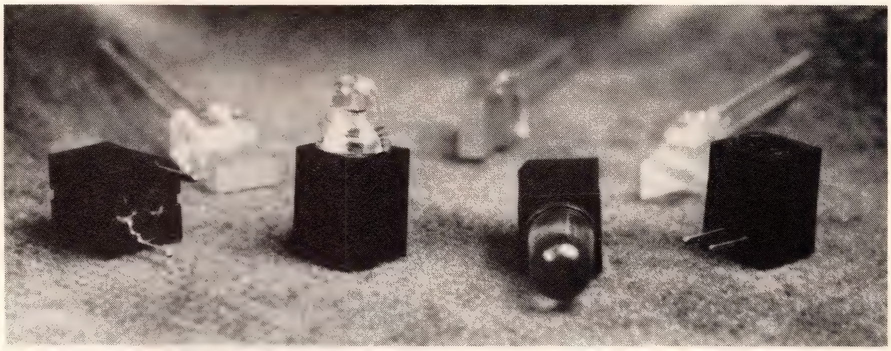
The CAH and CAF couplers offer half- or full-duplex operation, respectively, and combine an emitter, detector, and optical connector in one injection-molded plastic housing that mounts on a pc board. Model CAH accepts single-wavelength transmitted light at the connector port and directs it onto the system fiber by means of internal optical surfaces; the received light in turn is directed onto the device's detector. This beam-splitter action provides half-duplex transmission over a single cable. The −3-dB electrical bandwidth is 40 MHz. It also specs 10-μW optical power coupled into the fiber for 50/125-μm graded index, 50 μW for 100/140-μm graded index, and 180 μW for 200/240-μm step index. Model CAH features ±1-dB coupled-power variation, 800- to 860-nm operating wavelength, and responsivity of 0.24 A/W.

Model CAF coupler uses wavelength-division-multiplexing techniques to provide dual-wavelength, full-duplex transmission over one fiber. Transmit and receive wavelengths are separated by internal optical coatings; one each of the A (730-nm) and B (865-nm) versions are required for a full-duplex system. Typical specs include 10-μW optical power coupled into the fiber for 50/125-μm graded index, 100 μW for 100/140-μm graded index, and 350 μW for 200/240-μm step index. It also has ±1-dB coupled-power variation and 0.45 A/W responsivity. Model CAF, $250.

ADC Fiber Optics Corp, 8 Walkup Dr, Westborough, MA 01581. Phone (617) 366-0450. TLX 951356.

Circle No 529

Printed-circuit-board sockets simplify LED installation



If you've ever needed to replace LEDs that have been soldered to a pc board, you know how difficult, time consuming, and costly the task can be. The PCH and PCV Series sockets provide an inexpensive solution to this problem: They offer a reliable means of electrically connecting LEDs to pc boards without soldering. The sockets accommodate both low-profile and standard-length LEDs. Because they're compatible with wave-soldering techniques, you can mount the sockets along with the other components and assemble the board in one step.

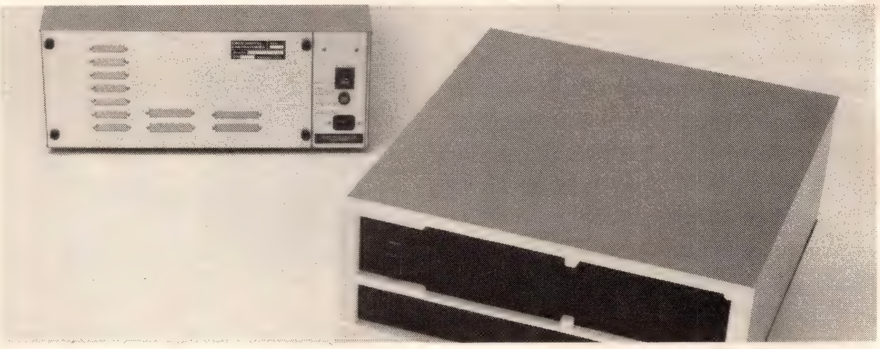
PCH devices accommodate horizontally mounting LEDs; PCV sockets handle LEDs that mount vertically. Both socket versions are molded from UL-listed nylon plastic and feature tin-plated phosphor-bronze contacts. You can insert and remove LEDs from either the front or the back of the sockets. The sockets' finger contacts automatically adjust to accommodate a variety of LED lead shapes and sizes. The LEDs must, however, have dual leads on 0.1-in. centers.

The sockets also feature polarity identification, standoffs, and lock-type vibration security. This security feature, which allows you to bend the LED leads after they've been inserted into the socket, makes the sockets suitable for use in high-vibration and high-shock applications. Further, the PCV sockets let you insert the LEDs through a hole in the back of the pc board, so they're suitable for use in applications involving dead-front-panel lighting, where space is usually limited. PCV and PCH Series sockets cost $0.25 (10,000).

Visual Communications Co, Box 986, El Segundo, CA 90245. Phone (213) 822-4727.

Circle No 528

Multibus system chassis includes 400W supply and 8-slot card cage



The Series VIII system chassis is suitable for use in workstations and other commercial or industrial OEM applications. The chassis accommodates eight Multibus cards and includes a 400W, 4-output power supply that provides 50A at 5V, 5A at −5V, 8A at 12V, and 3A at −12V.

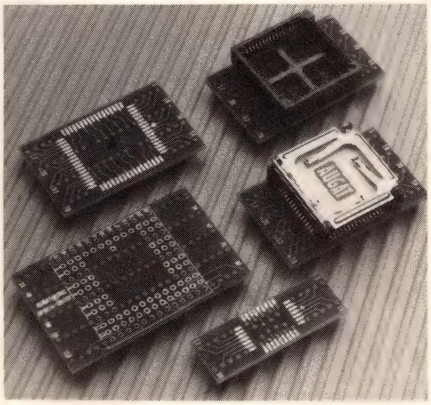
Cards are accessible through a removable rear panel that has I/O-connector cutouts for six 25-pin D-type, two 37-pin D-type, and two 50-pin D-type connectors, plus room for additional user-defined connector cutouts. Cards plug into an iLBX-compatible backplane whose ground plane and system bus are separated to ensure low-noise operation. Card cages are constructed of black anodized aluminum sheet metal. The backplane's system bus lines and 24 address lines are traced and terminated according to IEEE-796 standards.

The front panel features two ready-to-mount window cutouts that will accept two industry-standard 5¼-in. peripheral-drive units or four half-height units. A 115-cfm fan cools the enclosure by forcing filtered air through each card space, over the power supply, and out through a vent in the front panel. The chassis section meets FCC standards for RFI and EMI. The Series VIII meets UL and CSA safety regulations. $2395.

Chen Digital Laboratories, 4170 148th Ave NE, Redmond, WA 98052. Phone (206) 881-5031.

Circle No 530

Adapters allow use of surface-mount, pin-grid devices on a wire-wrapped board



The Densepak line of adapters lets you mount pin-grid and surface-mounted VLSI devices on conventional wire-wrapped boards, thereby eliminating the need to use multilayer circuit boards just to evaluate a new device. The adapters provide one-to-one connections with no wasted pins, and require only 20% more space than the VLSI package itself. You can mount these adapters side-by-side on 0.300-mil row spacing or end-to-end on 0.100-mil pin spacing to avoid wasting board area. Densepak includes the APG Series of pin-grid chip-carrier adapters and the SSM/RSM Series of surface-mount adapters for leaded and leadless chip carriers.

The APG Series includes 10 adapters, which accept more than 150 I/O-pin options for pin-grid devices ranging from 9×9 to 15×15 positions. Pin densities match that of the wire-wrapped panel, so no terminals are wasted. The adapter has zero-profile Holtite sockets that secure the pins of the pin-grid device; each of these socket positions are identified by silk-screened characters. Circuit traces are protected by an insulated covering.

The SSM (square surface-mounting package) and RSM (rectangular surface-mounting package) line of adapters lets you develop prototype circuits on wire-wrapped panels or standard pc boards, using plastic or leaded or leadless ceramic chip carriers. The adapters are available with or without pin sockets, covering two to five wire-wrapped rows, with as many as 18 pins per row. The adapters cost $5 to $50, depending on size and configuration.

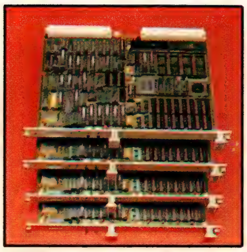
Augat Inc, Components Div, Box 779, Attleboro, MA 02703. Phone (617) 222-2202. TWX 710-391-0644.

Circle No 531

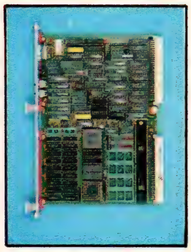
THE HI-PERFORMANCE PEOPLE **ELECTRONIC MODULAR SYSTEMS INC.**

VMEbus Central Processors

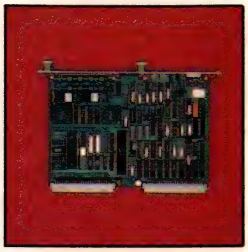
REAL TIME APPLICATIONS



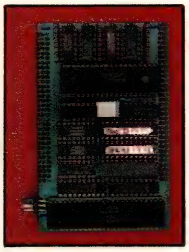
CPU-2RT



CPU-2SC



CPU-2PB

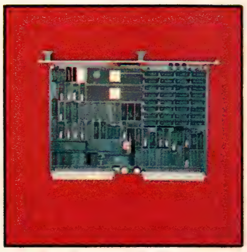


PIGGY BACK BOARDS

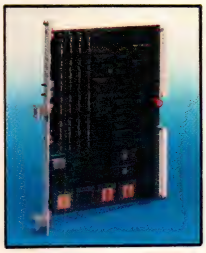
68020
@ 12.5 MHz,
16.5 MHz, or
20 MHz,
DRAM ¼ Mb,
1 Mb, or 4 Mb

CPU-4RT

STAND ALONE HOST



CPU-1



CPU-3

	STAND ALONE HOST		REAL-TIME MASTER/SLAVE			
	CPU-1	CPU-3	CPU-2RT	CPU-2SC	CPU-2PB	CPU-4RT
MICROPROCESSOR	68000/68010	68010	68000/68010	68000/68010	68000/68010	68020
FREQUENCY	8MHz	12.5 MHz	12.5 MHz	12.5 MHz	12.5 MHz	12.5 - 20 MHz
MEMORY MANAGEMENT	68451	68451 (2nd as option)				
DMA	LOGIC		68450 option	68450 option	68450 option	
FLOATING POINT PROCESSOR		68881 (option)			68881 (option)	68881 (option)
RAM (DUAL PORTED)	256 Kb	2 Mb	128/512 Kb	128/512 Kb	512 Kb	1/4, 1, 4 Mb
EPROM		2 Sockets (128 Kb)	2 Sockets (128 Kb)	2 Sockets (128 Kb)	2 Sockets (128 Kb)	2 Sockets (128 Kb)
EEPROM			2 Sockets (16 Kb)	2 Sockets (16 Kb)		
SIO	1 PORT	1 PORT	2 PORTS	4 PORTS	• I/O ON PIGGYBACK BOARDS • PB-SCSI1 SCSI/DMA • PROTO BD	3 PORTS
PIO	1 PORT		1 PORT			
TIMERS	1	4/ 8 bit	3/ 16 bit			1/ 32 bit
ADDITIONAL FEATURES	1K PROM FLOPPY DISK CONTROLLER	Translation Cache	R/T CLOCK 58274	R/T CLOCK 58274		
SOFTWARE	UNIX* SYS V	UNIX* SYS V pSOS**	pSOS** PDOS***	pSOS**	pSOS**	pSOS** PDOS***

ONE YEAR WARRANTY

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**pSOS is a trademark of Software Components Group

***pDOS is a trademark of Eyring Research

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Telex: 791688 Pasadena Dal

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6078 Neu-Isenburg
West Germany
06102/3117
Telex: 841/4185633 EMS D

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Maiden Head, Berks S167DE England
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Madurai 625-002 India
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Telex: 953/445-320 SCT IN

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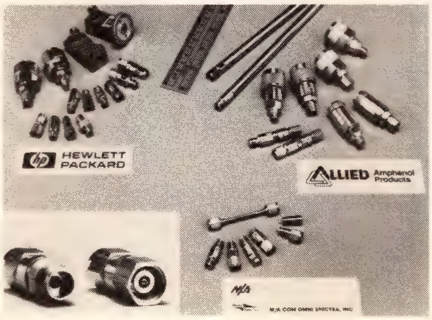
CIRCLE NO 193

Joint development results in compatible family of 50-GHz coaxial connectors

Hewlett-Packard, Amphenol Products (Lisle, IL), and M/A-COM Omni Spectra (Merrimack, NH) have jointly developed a family of compatible coaxial connectors that are specified from dc to 50 GHz. Called "2.4-millimeter connectors" to signify the inner diameter of the coaxial system's outer conductor, the connectors come in industrial, instrumentation, and metrology grades.

The production-grade connectors are suitable for use in systems, components, cabling, and microstrip-transmission media. Developed and manufactured by M/A-COM and called the OS-50 Series, this grade emphasizes economy and simplicity.



It includes connector plugs and jacks and "between series" adapters that allow connection to SMA, 3.5-mm, 7-mm, 2.92-mm, and Type-N coax systems.

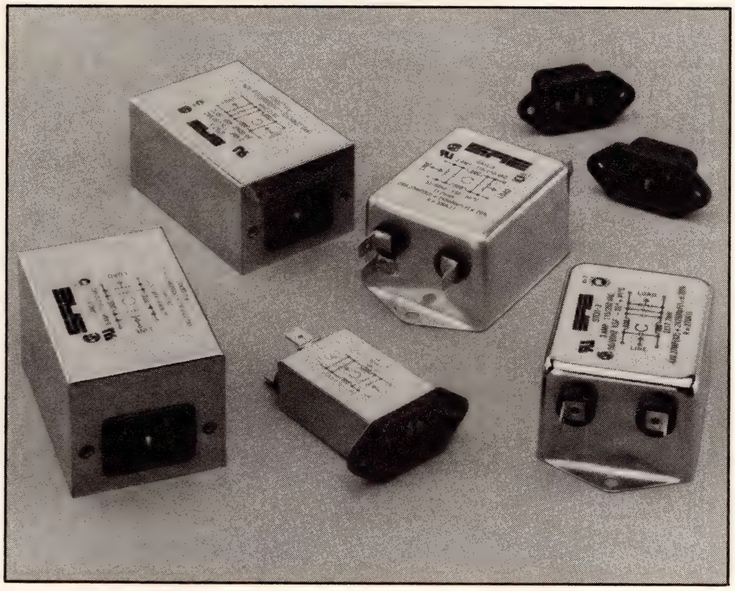
Amphenol's APC-2.4 Series of instrument-grade connectors are suitable for test and measurement equipment in which connectors are subjected to many cycles of connect/disconnect. This grade includes adapters as well as connectors for coaxial air-dielectric transmission lines and test instruments.

HP will concentrate on the development and manufacture of the more expensive metrology-grade connectors and adapters, which feature direct traceability to national measurement standards through their well-defined mechanical dimensions. Prices for between-series adapters range from $325 to $500.

Hewlett Packard, Network Measurements Div, 1400 Fountaingrove Pkwy, Santa Rosa, CA 95401. Phone local office.

Circle No 532

Listen to the Quiet at SAE.



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High performance filters provide high attenuation for low impedance loads and are designed to withstand severe EMI environments.

Switching transients are reduced to acceptable levels with the STE filters. These quality filters help meet VDE and FCC specifications.

Special applications are no problem at SAE. SAE's design group can provide the answer to custom mechanical or electrical requirements.

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SAE YOUR SILENT PARTNER EMI Filters

Some items pending CSA and TUV.

SAE Stanford Applied Engineering

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Santa Clara, CA 95050-1997
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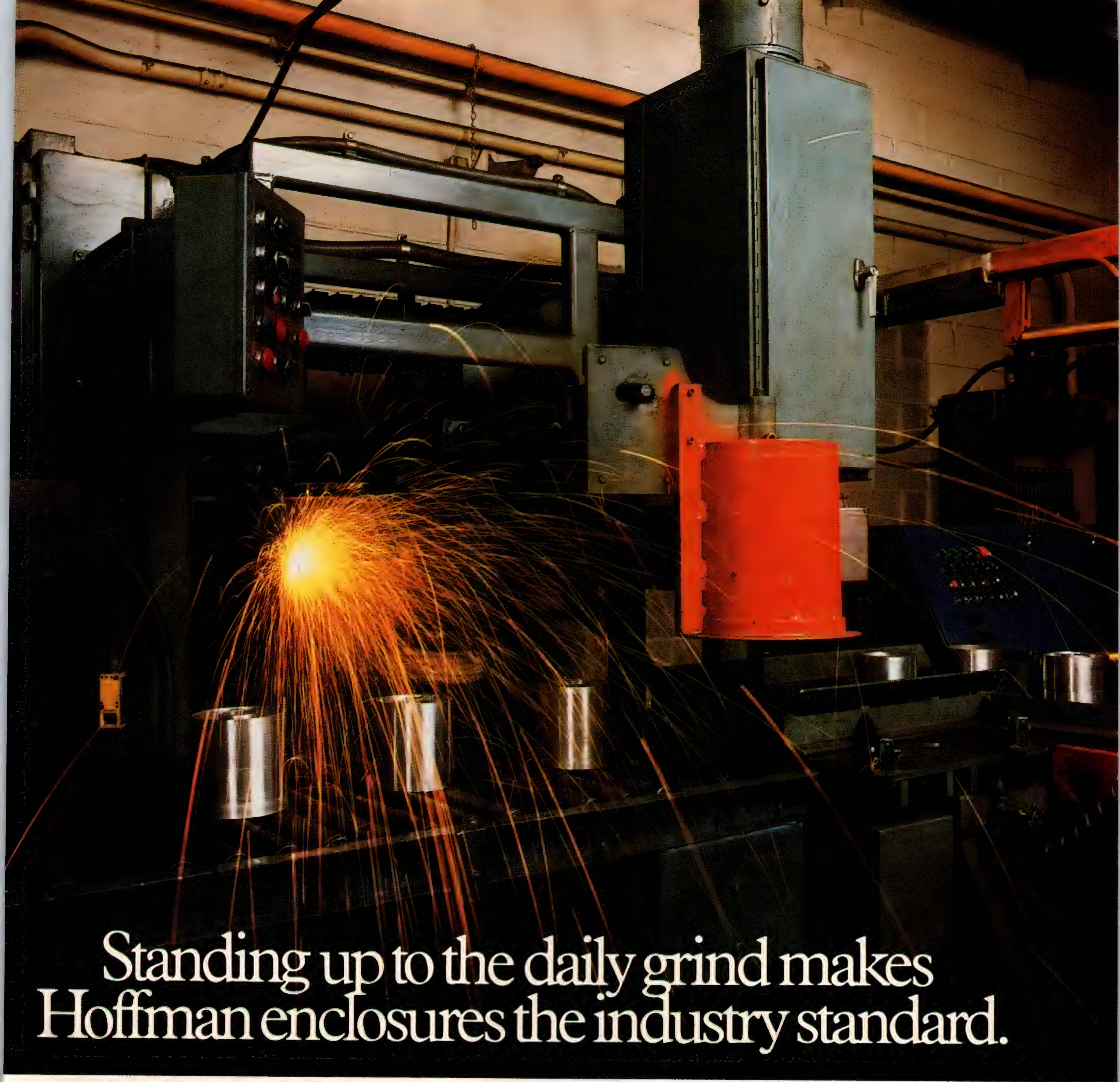
Standing up to the daily grind makes Hoffman enclosures the industry standard.

We don't have to tell you about the daily grind your enclosures must endure. Where corrosion, grease, oil, salt spray and miscellaneous hard knocks are always ready to eat your sensitive controls and circuits alive. You just can't afford to entrust their integrity to lesser enclosures than Hoffman.

For one, Hoffman metallic enclosures have been guarding circuits in thousands of "daily grinds" for more than 40 years. We're constantly upgrading their design to keep pace with industry advances. We've been on the leading edge of production technology—in forming, welding, grinding and finishing—to make Hoffman enclosures the finest we can make them.

We offer more than 2,000 metallic enclosures from stock in a wide variety of JIC and NEMA types as well as UL, CSA and IEC ratings. You'll find complete specs and product descriptions in our newly updated Specifier's Guide. For your free copy, write us, on your company letterhead, and send to the address and department listed below.

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900 Ehlen Drive Anoka, Minnesota 55303 Phone: (612) 421-2240 Dept. EDN-8618

CIRCLE NO 177

Here's a list of all backplane interconnection density issues:

1. Signal Density
2. Board Real Estate
3. Board Stiffness
4. Daughtercard Spacing
5. Low Insertion Force
6. High Normal Force
7. Contact Alignment
8. Fine Line Technology
9. Surface Mount Compatibility

Here's a list of companies who address them all:

1. Teradyne
2.
3.
4.
5.

Whether you're using LSI, VLSI or VHSIC . . . CMOS, ECL or Schottky,
Teradyne's systems approach will successfully address your
density issues and meet your cost, reliability and time-to-market objectives.
If density is really an issue with your backplane system,
call us today for more information. Teradyne Connection Systems,
44 Simon Street, Nashua, NH 03060. (603) 889-5156.

TERADYNE

Connecting problem . . . and solution

CIRCLE NO 176

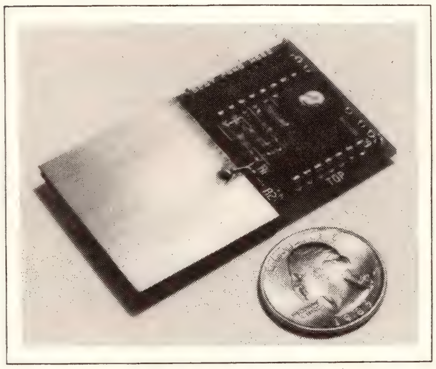
Hardware and Interconnect Devices

DIN CONNECTORS

The RNE Series standard and inverse DIN 41612 connectors feature selective loading of extended pins. The pins provide first-to-make, last-to-break ground contacts that protect sensitive CMOS circuitry from static discharge and high-voltage shock. The series is available with 32, 64, or 96 pins in either straight- or right-angle-mount styles. $0.04 per contact (100). Delivery, eight weeks ARO.

Robinson Nugent Inc, 800 E 8th St, New Albany, IN 47150. Phone (812) 945-0211.

Circle No 533



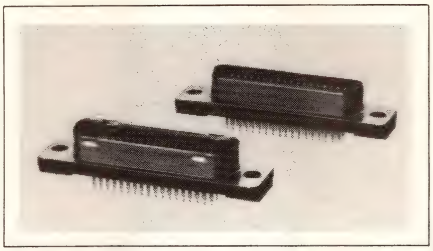
PIEZOELECTRIC FANS

Series LP-1200 low-profile dc-operated fans are suitable for applications requiring concentrated air flow or cooling in severe environments. Each fan provides, on demand, a planar airjet that has an average velocity greater than 250 feet/minute in an airstream of 1.5×1.5×0.25 in.

Measuring 2.7×1.5×0.25 in. and weighing 0.6 oz, the 12V model delivers 0.8 cfm continuously and consumes 50 mW. A 24V model delivers 1.5 cfm and uses less than 200 mW. The fans are fully wave solderable. According to the manufacturer, RFI and EMI are negligible and start-up is virtually instantaneous without the power surges usually encountered with conventional fans. $250.

Piezo Electric Products Inc, 240 N Washington Blvd, Sarasota, FL 33577. Phone (813) 366-1458.

Circle No 540



PC CONNECTORS

Series 266 IEEE-488 shielded pc-board connectors are available with 0.125- and 0.17-in. tail lengths. They are preassembled to ease board installation. A plug version is available in grid patterns measuring 0.085×0.151 in. or 0.085×0.160 in.; a receptacle version comes in 0.085×0.169-in. or 0.085×0.160-in. patterns. Both versions are available in 24-, 36-, and 50-position versions.

You can choose from a variety of screw-lock hardware kits and grounding straps, depending on your application. The connectors feature copper-alloy contacts with selective gold-over-nickel plating on the mating end and tin on the tail. 36-position connector, $2.14 (5000).

Winchester Electronics, Main St and Hillside, Oakville, CT 06799. Phone (203) 755-5000.

Circle No 536

TERMINAL STRIPS

The Series 700 terminal strips feature UL and CSA listings (and also comply with VDE requirements), 5- and 10-mm centers, a flat base, and straight- or right-angle pc-board-compatible terminals. Five-mm center strips are available with two to 32 positions; 10-mm center strips have two to 16 positions. The strips include captive top screws. A wire-protector plate on each position distributes the pressure on the wire. All terminals are tin-plated copper for high-reliability solder connections. A 10-position unit, $1.25 (1000).

Magnum Electric, 6385 Dixie Hwy, Erie, MI 48133. Phone (800) 521-0330.

Circle No 543

CARD CONNECTORS

Offering 20 to 684 contacts, Series 9082 2-row, Series 9083 3-row, and Series 9084 4-row connectors have standard keying; the 3- and 4-row versions also come in no-guide-pin, single-guide-pin, or double-guide-pin variations. The 0.1-in. centerline, 0.025-in. square-post connector is made of high-temperature thermoplastic and is available in pc-board and wire-wrap straight posts and compliant-pin post terminations.

The mating receptacle provides a 1.5-oz max insertion force and a normal force of 70g. Series 9082, $0.14 to $0.15 per line; 9083, $0.13 to $0.14; 9084, $0.12 to $0.13 (1000). Delivery, eight to 10 weeks ARO.

Elco Corp, Connector Div, Huntingdon Industrial Park, Huntingdon, PA 16652. Phone (814) 643-0700.

Circle No 535

TYPE-D CONNECTORS

These male and female insulation-displacement connectors directly accept 0.05-in. pitch cable and include feedthrough covers to permit chain interconnections. The type-D subminiature connectors accommodate 30-AWG solid and 28- or 26-AWG stranded conductors. They have metal shell protection and shielding at the mating interfaces and are available with screw locks, check nuts, slide-lock retainers, or spring-lock retainers. In addition, you can purchase the connectors with integral 4/40 nut mounting hardware and full strain-relief caps.

Connector moldings are glass-filled polyester with a UL flammability rating of 94V-0. Contacts are copper-based alloy, and contact plating is 50-μin. nickel with 30-μin. gold at the plug area. $6.85 for a 50-position connector (OEM qty).

Carrot Components Corp, 750 W Ventura Blvd, Camarillo, CA 93010. Phone (805) 484-0540. TWX 910-336-1237.

Circle No 541

Installing Electronic Connectors?

Use Greenlee Electronic Connector Punches for Fast, Accurate Cut-Outs!

Greenlee Tools' expanded line of five electronic connector panel punches provides a quick, clean and accurate cut-out for 9, 15, 25, 37 and 50-pin connectors.

Greenlee electronic connector punches provide these outstanding features:

- **Fast, accurate panel punching; no sawing or filing required.**
- **Drill only one 7/16″ pilot hole.**
- **Cut-out and mounting slots are punched in one operation.**
- **Use either manual wrench or hydraulic punch driver methods.**
- **Universal size punch for front or back mount of TRW cinch and ITT Cannon-type or equivalent D-subminiature connectors.**

See your nearby Greenlee Tool Distributor for the full story on all of the Greenlee Panel Punches including round, square, rectangular, "D", Double "D", "Key" and "Keyway" shaped punches.

Greenlee Tool also offers a full line of time-saving hydraulic and ratchet punch drivers for meeting your punching needs.

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800/435-0786, in Illinois call 815/399-3903.

CIRCLE NO 101

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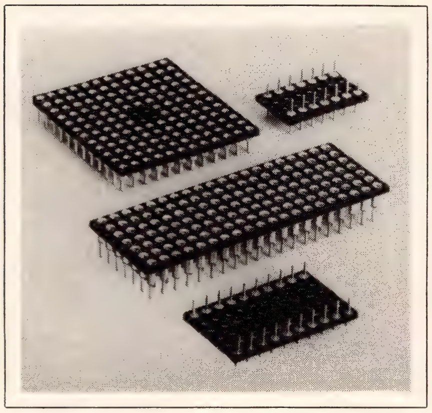
Hardware and Interconnect Devices



CONNECTORS

These high-temperature surface-mount connectors are suitable for vapor-phase and infrared soldering operations as high as 216°C. Lead sockets and terminals are physically loose in the connector body to allow realignment when stressed by the body and terminals' different coefficients of expansion. Socket heads are seated flush with the body's top surface, and the tail promotes a reliable solder connection during surface assembly. Connectors are available in many pin configurations, with grids as large as 20×20. From $0.28 (1000), depending on size and style.

Samtec, Inc, Box 1147, New Albany, IN 47150. Phone (812) 944-6733. TLX 333918.

Circle No 544

FLAT CABLE

The AC Series gray flat cable and CSK Series multicolored cable are available in 100-ft reels. The AC line comes with 10 to 64 conductors and the CSK has nine to 64 conductors, all on 0.05-in. center spacings. Wire gauge is 28 AWG, and maximum operating rating equals 105°C. Both series accommodate currents of 1A. Voltage rating equals 300 and 250V for the AC and CSK cables, respectively. 26-conductor AC, $17.63; 26-conductor CSK cable, $33.97. Delivery, stock to six weeks, ARO.

Amlan Inc, 97 Thornwood Rd, Stamford, CT 06903. Phone (203) 322-1913.

Circle No 542

HEAT SINKS

Models 6214 and 6216 provide maximum thermal performance using a minimum of pc-board space. They provide better heat transfer from the TO-3 transistor because of thick metal construction and tall sides with more surface area to dissipate heat. The wrap-around design results in less wasted material in manufacturing and keeps the cost low.

Model 6214 measures 1¾ in. high and has a thermal resistance of 4.7°C/W at 75°C mounting surface temperature rise. Model 6216 is 2¼ in. high and has 4°C/W thermal resistance. A choice of solderable studs or nuts provides wave-soldering compatibility. 6214, $0.44; 6216, $0.49 (1000).

Thermalloy Inc, Box 810839, 2021 W Valley View Lane, Dallas, TX 75381. Phone (214) 243-4321.

Circle No 534

HEAT SINKS

Series 5197-5201 heat sinks replace cast-aluminum heat sinks, reducing costs by 30 to 40% and also reducing package size. Each device is stamped from ⅛-in.-thick aluminum and is designed for use with TO-3, TO-66, TO-220, TO-218, and similar devices. Measuring 1.900 in. long and 1.550 in. wide, the devices are available in four heights from 1.225 to 2.00 in. The finned design provides free circulation of air from all sides. With an input of 10W, the smallest heat sink has a 50°C rise above ambient under natural convection. You can mount the semiconductor and a heat sink to the pc board with the same screws. The heat sinks are available in several finishes, including black, bronze, blue, or red anodized, as well as gold chromate. $0.637 (1000).

Aavid Engineering Inc, Box 400, Laconia, NH 03247. Phone (603) 524-4443.

Circle No 539

F-O MODULES

These high-performance fiber-optic transmitters and receivers come in corrosion-resistant packages and include photodiodes characterized by low capacitance, low dark current, and high responsivity, according to the manufacturer. The laser-based transmitter devices are compatible with 1.3-μm fiber-optic systems using single-mode fibers. They operate at data rates to 565M bps and spec an optical output to −1 dBm.

The transmitters use an injection laser, a photodiode monitor, interface circuitry, and a thermoelectric cooler. Each laser diode comes with a single-mode, fiber-optic biconic-connector termination. Four receiver devices are available. They are designed for use in 1.3- to 1.55-μm long-wavelength communication systems and operate at data rates as high as 417M bps with sensitivities to −52 dBm. Transmitters, $4500 to $5760; receivers, $1600 to $3000. Delivery, 14 to 16 weeks ARO.

AT&T Technology Systems, 1 Oak Way, Rm 2WC-106, Berkeley Heights, NJ 07922. Phone (800) 372-2447.

Circle No 538

GPIB ACCESSORIES

This complete family of GPIB accessories, such as cables, connectors, and adapters, conforms to the IEEE-488 standard covering digital interface for programmable instru-

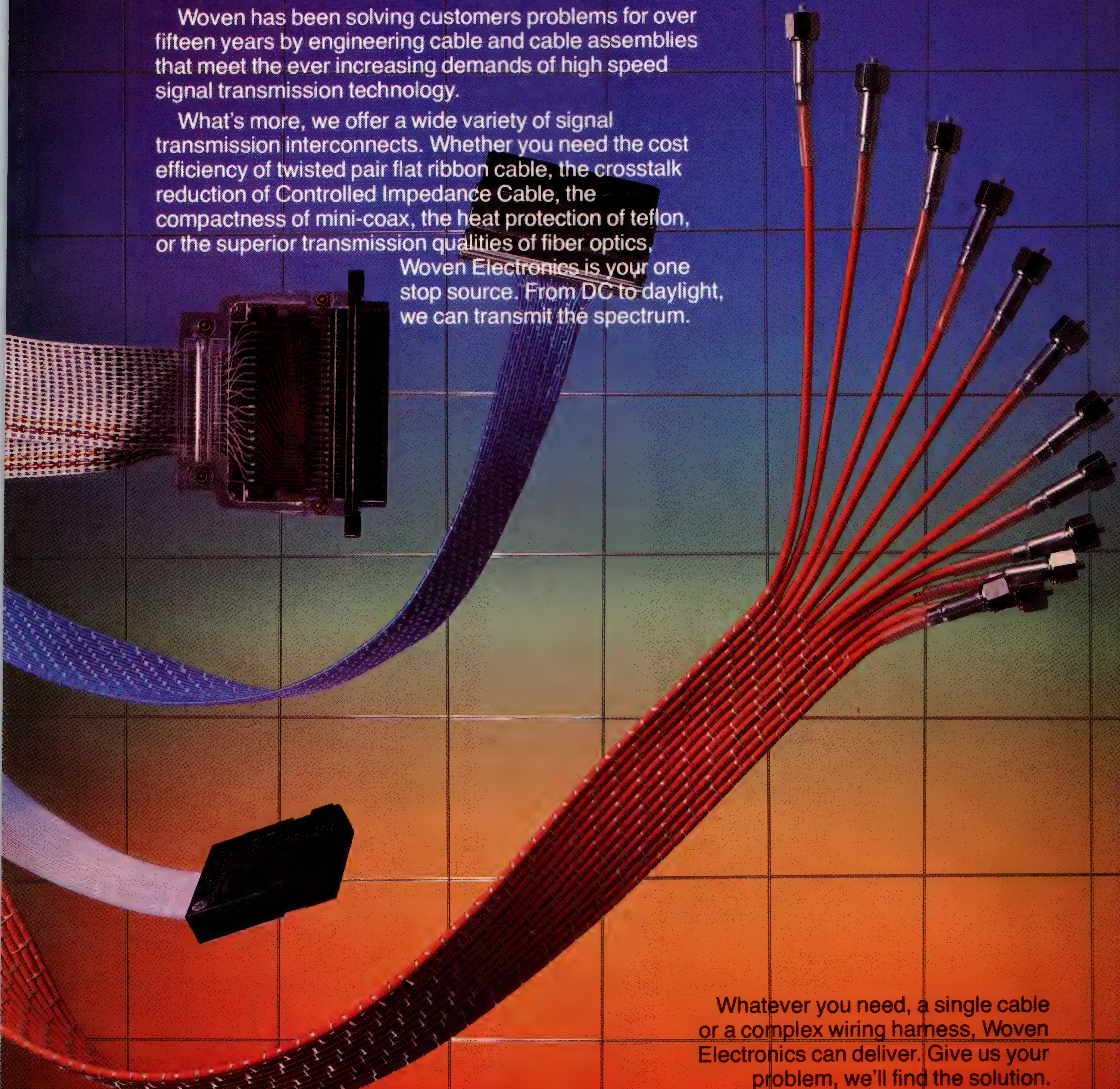
WOVEN ELECTRONICS®

Transmitting the spectrum from DC to Daylight.

When system speeds increase beyond the capability of conventional wiring, you need an expert. An expert who knows how to solve your problem. You need Woven Electronics.

Woven has been solving customers problems for over fifteen years by engineering cable and cable assemblies that meet the ever increasing demands of high speed signal transmission technology.

What's more, we offer a wide variety of signal transmission interconnects. Whether you need the cost efficiency of twisted pair flat ribbon cable, the crosstalk reduction of Controlled Impedance Cable, the compactness of mini-coax, the heat protection of teflon, or the superior transmission qualities of fiber optics, Woven Electronics is your one stop source. From DC to daylight, we can transmit the spectrum.



Whatever you need, a single cable or a complex wiring harness, Woven Electronics can deliver. Give us your problem, we'll find the solution.

WOVEN ELECTRONICS® *the signal is clear!*

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CIRCLE NO 175

And, we have all the little fastener things you need to make your big things work better.

For fasteners of every type to help make your electrical, electronic or electro-mechanical things look and work better you can't find a more complete line than RICHCO. The industry leader.

Whether your need is for simple ties, cable clamps or more sophisticated saddles and other fastener hardware for pc boards, it's here. In designs and sizes that are just right for your specs. And, at prices that are right, too!

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SAMPLE DEPARTMENT
Toll Free 800-621-1892 In Illinois 312-539-4060

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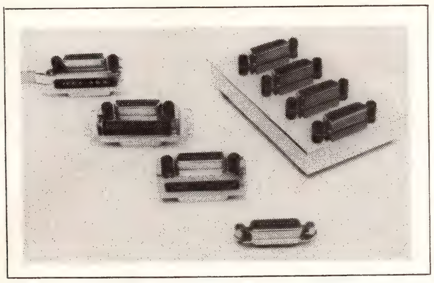
Chicago, Illinois 60680

CIRCLE NO 174

Hardware and Interconnect Devices



mentation. To reduce crosstalk and radiated emissions, the cables feature two braided shields with additional foil shielding on the inner and outer layers. The cables' outer jacket is a blend of vinyl and rubber that allows a 1-in. bend radius. The nickel-plated cast-aluminum connectors have an overlapping shell seam that provides an uninterrupted electrical shield; a reinforced strain relief prevents the cable and connector from separating when subjected to sharp bend angles.

Other products include a 1-in. extender to provide clearance at the rear panel of an instrument, a bulkhead, 90° adapters, switch boxes, and connector sockets. A multitap bridging box allows you to stack connectors horizontally instead of on top of each other. 0.5m cable, \$57.50; 5m cable, \$79.50; extender, \$19.50; bulkhead adapter, \$22.50; 90° adapter, \$22.50; 2- and 3-switch boxes, \$145 and \$195, respectively; connector sockets, \$4.95; multitap bridging box, \$89.

L-Com Inc, 1755 Osgood St, North Andover, MA 01845. Phone (800) 343-1455; in MA, (617) 682-6936.

Circle No 545

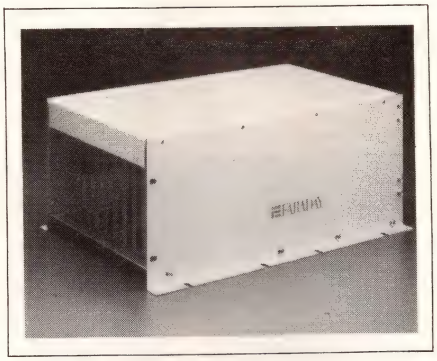
SOCKET

This pin-grid-array socket, an addition to the Preci-Dip line, matches the layout of Texas Instruments' Series 888, 890, and 897 μPs. It features a beryllium-copper 6-finger contact that provides an insertion force averaging 2.5 oz/pin. The contact design uniformly distributes forces around the mating pin and provides six points of electrical contact. A 45° funnel entrance facilitates device insertion, and brass sleeves prevent wicking and contamination from flux and solder.

The socket's insulator is available with or without a center window, which improves heat dissipation. Standard plating is 30 μin. of gold on the contact with tin plating on the sleeve or tin plating on both the contact and sleeve. \$6.15 (100). Delivery, six to eight weeks ARO.

IEE, Component Products Div, 7740 Lemona Ave, Van Nuys, CA 91405. Phone (818) 787-0311. TWX 910-495-1707.

Circle No 537

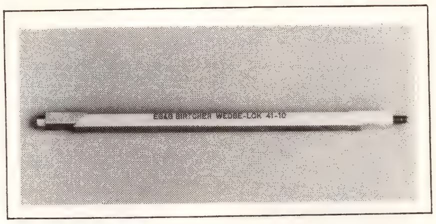


CARD CAGE

The FECC-8S sheet-metal chassis houses IBM PC and PC/AT single-board computers and third-party expansion boards, letting you imbed the PC and PC/AT bus architectures in an OEM product. The chassis also lets you upgrade from 8- to 16-bit structures with minimal software changes. It contains an 8-slot cage that accommodates pc cards on 0.8-in. centers, a power-supply connector, and two movable stand-up card guides that accept cards of various lengths. Also, the chassis includes provision for installation of an HP 3½-in. industrial hard-disk drive (HP 97501A). A fan bracket and perforated top cover are available as options; with these included, the dimensions are 16×6.3125×8.875 in. \$445, without options.

Faraday Electronics, 743 Pastoria Ave, Sunnyvale, CA 94086. Phone (408) 749-1900. TLX 706738.

Circle No 555



PC CARD GUIDE

The 41 Series Wedge-Lok is a low-profile locking guide designed to secure pc boards that are subjected to heavy shock and vibration. The guides are made of extruded aluminum, contain a stainless-steel screw, and come in 3-, 4-, 5-, and 6-in. lengths. You mount the guides to the pc board using rivets, screws, or adhesives; the guide makes close contact with the board for maximum heat transfer. Expanding the guide to a maximum 0.225 in. allows zero entry force for insertion and removal of boards. For 5-in. length, \$4.25 (1000). Delivery, seven weeks ARO.

EG&G Birtcher Industrial Products, Box 5268-91734, El Monte, CA 91731. Phone (818) 442-2572.

Circle No 546

DIP ADAPTERS

Dip-Adapter reconfiguring sockets let you change an IC without re-engineering your pc board. The socket contains a miniature pc that reroutes pin connections. You install the Dip-Adapter in place of the old IC and plug the new IC into the Dip-Adapter. You can specify 14-, 16-, 18-, 20-, 24-, 28-, and 40-pin socket versions. Pin sockets have double-sided, selectively gold-plated contacts. The body is 0.385 in. high and is made of 94V-0-rated, black Rynite polyester thermoplastic. You can specify the desired pin connections in a worksheet section of the product data sheet. A 28-pin Dip-Adapter that converts the TI 2564 EPROM footprint to that of the TI 2764 EPROM, \$3.95 (1000).

4C Electronics Inc, Box 868, Mentor, OH 44060. Phone (216) 354-6800. TLX 361717.

Circle No 551

CONNECTOR TAPE

H100 and H127 conductive connector tapes have 1- and 0.5-mm center-to-center spacings, respectively, between conductor stripes. These tapes are suitable for use with membrane switches, for connecting LCDs to pc boards, and for interconnecting flexible or rigid pc boards. The tapes consist of conductive silver stripes regularly spaced on a polymer backing, each coated with an adhesive containing conductive particles. About 6 sec are required for bonding the tape to a substrate, which results in a permanent adhesive bond with high peel strength. These tapes and two others (with 2- and 0.1-mm conductor spacings) come in a variety of widths and in lengths of 18, 36, and 90 yards. Price, $0.20/in^2.

3M, Electrical Products Div, Dept EL86-20, Box 33600, St Paul, MN 55133. Phone (612) 733-9534.

Circle No 550

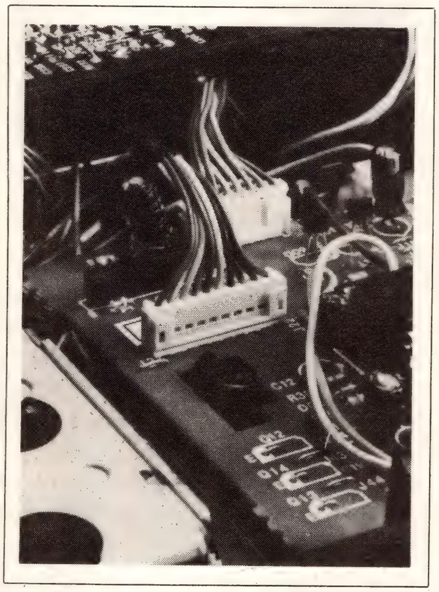
ZIF CONNECTORS

Zero-insertion-force (ZIF) card-edge connectors with 0.125- and 0.156-in. pin spacing have been added to the company's 0.100-in. line. Designed for double-sided pc boards, the connectors feature a double-action contact spring that provides a minimum 150g (200g typ) of normal force. You can insert a pc board edge-on, or slide it into the connector parallel to the card slot.

Connectors come in standard models with as many as 130 contacts (65 contacts in each of two rows) and with short or long solder-pin terminations. You can gang the connectors to activate as many as 130 dual positions with one lever. Materials include a glass-filled polyester body, tin-alloy-plated contact tails, and nickel-underplated, phosphor-bronze contacts, with selective gold plating at the contact area. 36-position connectors with 0.125- and 0.156-in. spacings, $6.48 and $6.79 (1000), respectively. Delivery, 6 weeks ARO.

Precision Connector Designs Inc, 5 Lowell Ave, Winchester, MA 01890. Phone (617) 721-1280.

Circle No 548



IDC CONNECTORS

The KR Series connectors offer 2-mm pitch and a profile less than $\frac{9}{32}$ in. above the pc board. They are fully polarized, come in top- or side-entry types, and offer two to 12 circuits each. The connector housing provides strain relief by gripping the insulation of each individual wire. At a suitable distance beyond the strain relief, each wire is gripped by a tin-plated twin U-slot that achieves electrical contact by displacing the insulation.

Ratings include 1A ac or dc, 100V ac or dc, −25 to +85°C temperature range, and 1000-MΩ minimum insulation resistance. You can assemble connectors with hand presses or with fully automatic equipment capable of 15,000 terminations per hour. Less than $0.02 per circuit (terminal) at a quantity of 50,000 terminal/header pairs.

JS Terminal Corp of America, 1380 Brummel Ave, Elk Grove Village, IL 60007. Phone (312) 956-7715.

Circle No 547

VERTICAL CABINETS

You can order these single- or multiple-bay vertical cabinets in a choice of 10 colors. For vertical enclosures only, the textured-finish doors and the top and side panels may be ordered in pottery white, gold, russet, light blue, silver, gunmetal, black, light green, red, or medium blue. Frame assemblies are black and must accompany the panel orders. For a $28\frac{9}{16}\times19\times30$-in. enclosure, $290.15 to $478.90, depending on the configuration.

AMCO Engineering Co, 3801 N Rose St, Schiller Park, IL 60176. Phone 1-800-833-3156.

Circle No 552

CABINET COOLER

Model CC400F compact cabinet cooler mounts flush with the outside of an electronics enclosure. The cooler's only moving parts are two fans that dissipate 15W each. Operating on 115V, 50 to 60 Hz or 230V, 50 to 60 Hz, the 11-lb unit measures $22\times5\frac{1}{2}\times4$ in. and has a 7×22-in. flange. The temperature of an uninsulated $24\times24\times16$-in. cabinet, for example, is 20°C above ambient when 195W is dissipated within the cabinet. With the addition of the CC400F, the cabinet can maintain the same temperature while dissipating 603W. $470 (50).

Noren Products Inc, 3543 Haven Ave, Menlo Park, CA 94025. Phone (415) 365-0632.

Circle No 549

When Choosing Quality The Choice Is LEMO Electronic Connectors

LEMO B Series quality connectors available in multicontact from 2 to 64 contacts, or unique coaxial-multicontact, or high voltage multicontact configurations

SPEED: Connectors engage and disengage simply and quickly by pushing and pulling axially with the mated connector.

SPACE SAVINGS: Only finger clearance on two sides needed to engage and disengage connectors. No need to twist or turn locking ring.

RELIABILITY: Key/Keyway pattern provides mating exclusivity. Quick-Lok mechanism assures secure contact by audible click when lock is engaged. Color coding is available too.

RUGGEDNESS: Connector components are precision machined from brass bar and tubing stock, plated with copper and then nickel. Locking mechanism is totally protected by outer shell, virtually eliminating accidental disconnections, damage to locking mechanism, cables and contacts.

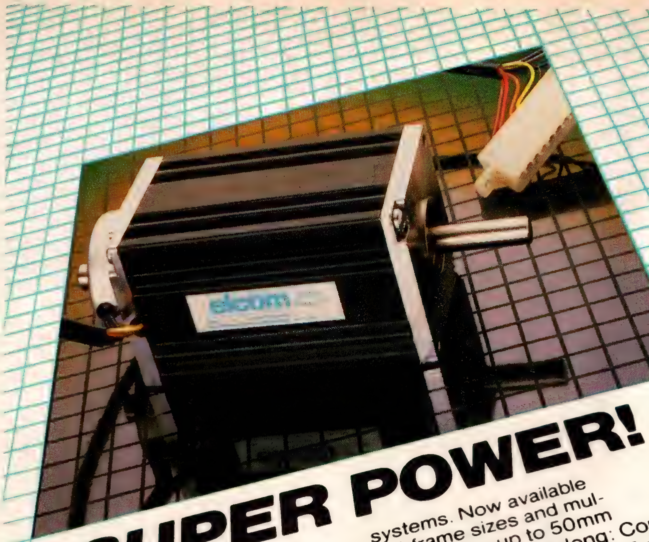
AESTHETIC-FUNCTIONAL DESIGN: Outer shell and back nut finished with matte chrome plating. Contacts are gold plated. LEMO connectors will complement any front panel application.

Over $1 million inventory stocked in Santa Rosa, California, sold by a network of representatives in North America.

For technical data and catalog, as well as the name of your local representative, please call or write LEMO U.S.A., INC. (707) 578-8811, P.O. Box 11006, Santa Rosa, California 95406.

LEMO USA INC

CIRCLE NO 172



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CIRCLE NO 48

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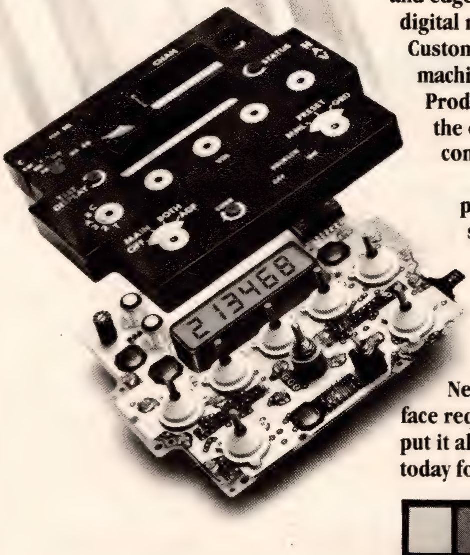

INTERFACE PRODUCTS, INC.
2185 S. Grand Avenue, Santa Ana, CA 92705
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CIRCLE NO 87

LCC SOCKET

Series 9074 low-profile, JEDEC leadless- chip-carrier sockets include surface-mount and through-hole solder-tail versions. At 0.250 in. high, the sockets allow you to mount boards on 0.500-in. centers. Available with 68 pins, the sockets accept JEDEC-type A LCCs with 0.050-in. pin centers; pins between the socket and pc board are on 0.100-in. centers. The hinged spring-steel cover and stainless-steel wire latch require no tools to open or close, and a steel biasing clip ensures correct registration of the chip carrier.

The cover accommodates heat sinks and allows you to electrically probe the chip carrier. Specs include 100g min normal force, a 20-mΩ max contact resistance, a 1.0-pF max pin capacitance, and a 5000-MΩ insulation resistance. Dielectric withstanding voltage is 5 kV; operating temperature range is −55 to +85°C. $0.065 per contact (5000). Delivery, six weeks ARO.

Elco Corp, Huntingdon Industrial Park, Huntingdon, PA 16652. Phone (814) 643-0700.

Circle No 554

CONDUCTIVE COATING

Cho-Shield 598 A/B is a conductive, 2-component silver-epoxy EMI coating. It provides resistance to salt-spray corrosion when applied to aluminum flanges that incorporate conductive EMI gaskets. After mix-

The hole story about fiberoptic connectors

The more concentric the hole in a fiberoptic connector, the more precise the alignment ...the lower the signal loss... the greater the efficiency of the system.

Augat Fiberoptic Connectors are produced with a hole tolerance held to an incredible +4, −0 microns. Concentricity is maintained within 2 microns of geometric center. (Ferrules are machined in Augat's Swiss facility by the world masters of precision components.)

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Best of all, you pay no more for the superior excellence of the finest fiberoptic connectors.

Our complete line of SMA style multimode connectors are available in Arcap and Nickel Plated Brass. We also offer a field installable single mode connector with less than .5dB insertion loss.

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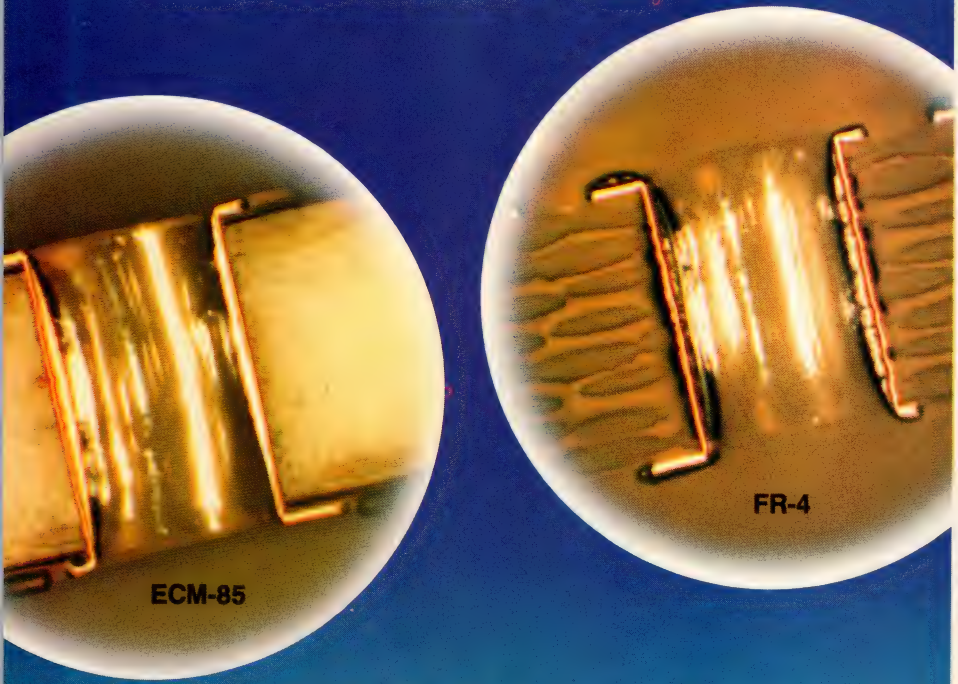
Quality and Innovation

CIRCLE NO 93

Look Into ECM-85



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Consistent PTH Quality. Put ECM-85, Cincinnati Milacron's all-glass laminate, up against FR-4 and you'll find it superior in processability and electrical performance. In head to head comparison, ECM-85 consistently provides superior drilled hole quality for PTH applications.

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Make Your Own Comparison. Call Cincinnati Milacron—toll-free—for more information, samples, and the name of your nearest ECM-85 approved fabricator.
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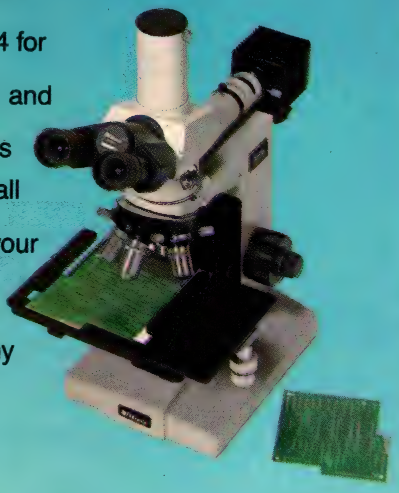
CINCINNATI
MILACRON

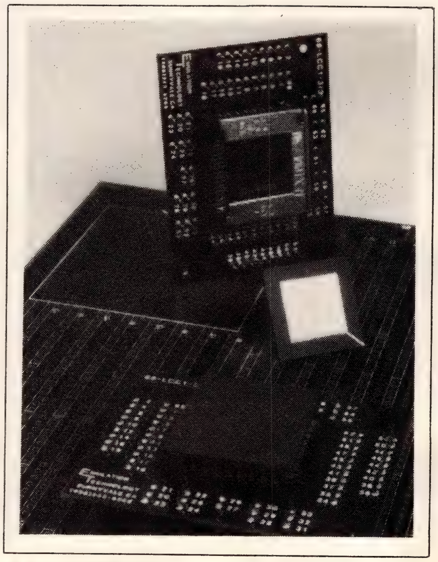
CIRCLE NO 126



ing the components together, you apply the coating with an air gun at room temperature. The compound dries to the touch within an hour and attains full chemical resistance in one week. Surface resistivity is 0.06 Ω/square based on a 1-hour cure at room temperature followed by a 1-hour cure at 250°C. The theoretical yield is 50 ft^2/lb for a 1.5-mm coating thickness, resulting in an approximate cost of $12 ft^2.

Chomerics Inc, 77 Dragon Ct, Woburn, MA 01888. Phone (800) 225-1936; in MA, (617) 935-4850.

Circle No 553



ADAPTER

Adapt-A-Board lets you mount leaded or leadless chip carriers and pin-grid-array packages on a breadboard designed for conventional DIPs. You can build prototype circuits using gate arrays, high-speed multipliers, and 68000/68010/68020 and 80186/80286/80386 microprocessors. Adapt-A-Board is currently available as a 68-pin (11×11) and 120-pin (13×13) array and in 68-pin LCC and plastic LCC configurations. Each includes a small, double-sided pc board with 0.025-in. square test points that are identified by labels. From $56.

Emulation Technology Inc, 422 Ives Terrace, Sunnyvale, CA 94087. Phone (415) 960-0652.

Circle No 556

LIF YOUR CAMS AWAY

LOW INSERTION FORCE (LIF) CONNECTORS BEAT ZERO INSERTION FORCE (ZIF) CONNECTORS 3 TIMES:

1. **WIPE:** contact wipe eliminates corrosion and disconnects caused by cable weight.
2. **COST:** jack screw coupling costs less than cam actuated coupling.
3. **RELIABILITY:** jack screw coupling eliminates intermittent contact.

The Hypertronics N-series of connectors eliminate the common problems of comparable ZIF connectors. They provide lower cost in high pin count models and applications flexibility:

- **70 to 700 contact positions**
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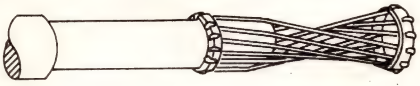
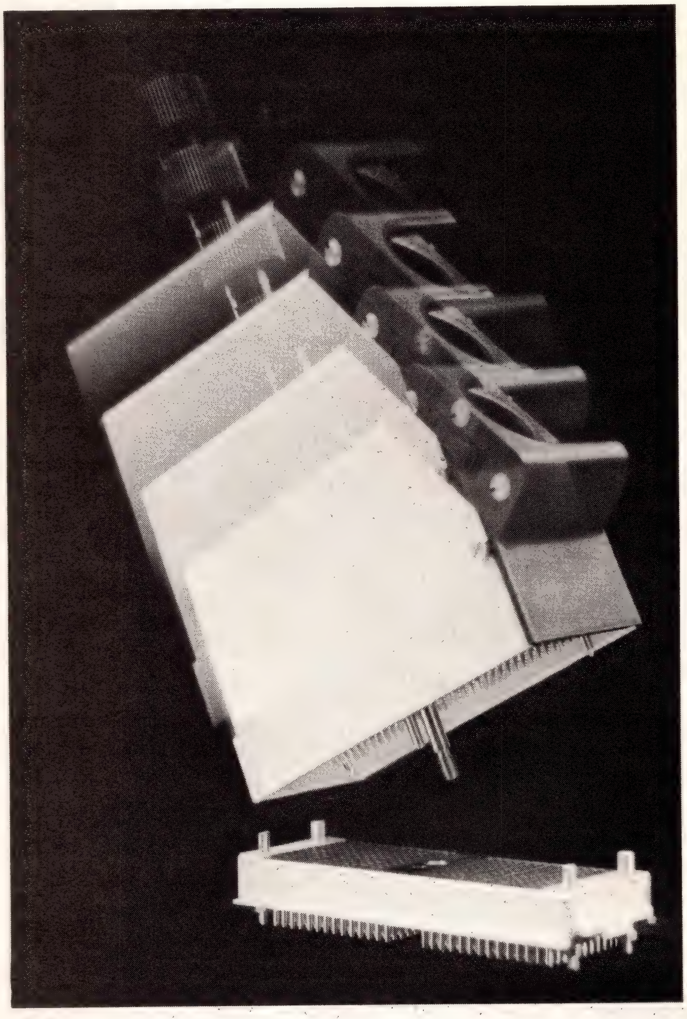
- **5 Amp and 9 Amp contacts**
- **Crimp, solder cup, wire wrap,® and dip solder termination.**

The N-series utilize the Hypertac® contact which provides:



- **Extremely low contact insertion/extraction force (as low as ½ ounce)**
- **Electrical continuity under extremes of shock and vibration (tested below 10 nanoseconds)**
- **Contact life exceeding 100,000 with excellent electrical repeatability**
- **Contact resistance under 5 milliohms.**

To learn more about these versatile connectors and which configurations are right for you, call us toll-free 1-800-225-9228 or write for a copy of our complete 1986 catalog.



® Wire wrap is a registered trademark of Gardner Denver.

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CIRCLE NO 171

AUDIO CONNECTOR

Type 302 and 303 miniature audio connectors have two and three low-voltage contacts, respectively. The connectors are less than 1 in. long and 0.25 in. in diameter and accommodate cables with a 3-mm max outer diameter. Rated at 3A, each contact is gold plated per MIL-G-45204B. Other features include valox insulation and self-latching, quick connect/disconnect operation. 302, $15.28 (10); 303, $17.42 (10).

Lemo USA Inc, Box 11006, Santa Rosa, CA 95406. Phone (707) 578-8811. TLX 340933.

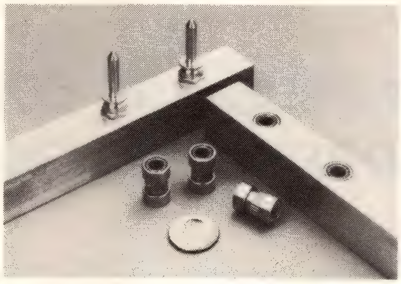
Circle No 558

BUS SOCKET

The 200A HPG241F32 Series socket and mating pin provides an alternative to flat and terminal cable assemblies. It is suitable for connecting bus bars to power supplies. You can also make pluggable bus bars that allow quick assembly for factory test, ease of shipment, and setup and checkout in the field. You assemble the socket by press fitting it into a machined recess in the bus bar. Three plating finishes are available: 50-μin. gold on contact surface, gold flash on body (AH suffix); 50-μin. gold all over the contact (H suffix); and 250-μin. gold on contact surface (L suffix). HPG241F32AH, $9.94 (100).

Hypertronics Corp, 16 Brent Dr, Hudson, MA 01749. Phone (800) 225-9228; in MA, (617) 568-0451.

Circle No 557

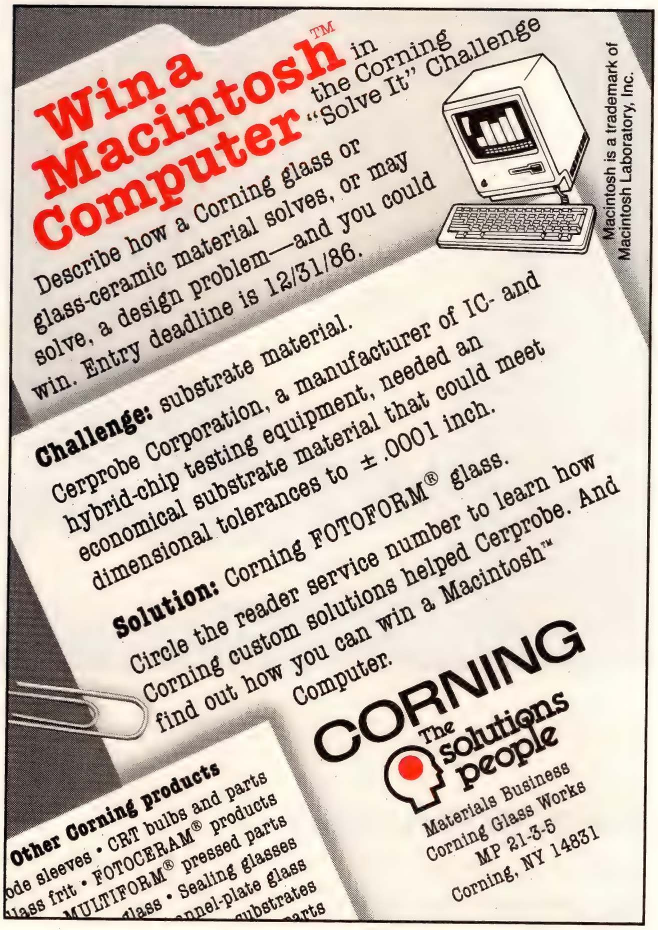


LIF SOCKET

This low-insertion-force socket with contacts on 0.050-in. centers is suitable for 64-pin microprocessors such as the Fairchild F9450, F9451, and F9452. The socket has a lever-actuated camming mechanism that positively locks the package in the socket. Probe holes along the top of the socket insulator allow insertion of test probes. Standard socket tails have 0.05×0.625-in. spacings; 0.100×0.100-in. spacing is optional. The socket can also be furnished with surface-mount contacts. Body material is 94V-0-rated glass-filled thermoplastic; contacts are made of beryllium-copper with a tin-lead-over-nickel finish (a gold-over-nickel finish is optional). Operating temperature is −50 to +125°C. $5.

Methode Electronics Inc, Interconnect Products Div, 1700 Hicks Rd, Rolling Meadows, IL 60008. Phone (312) 392-3500.

Circle No 559



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CIRCLE NO 165

DID YOU KNOW?

EDN publishes two Technical Article Databases per year that list the feature articles published in the preceding six months in *five* of the leading electronic engineering publications.

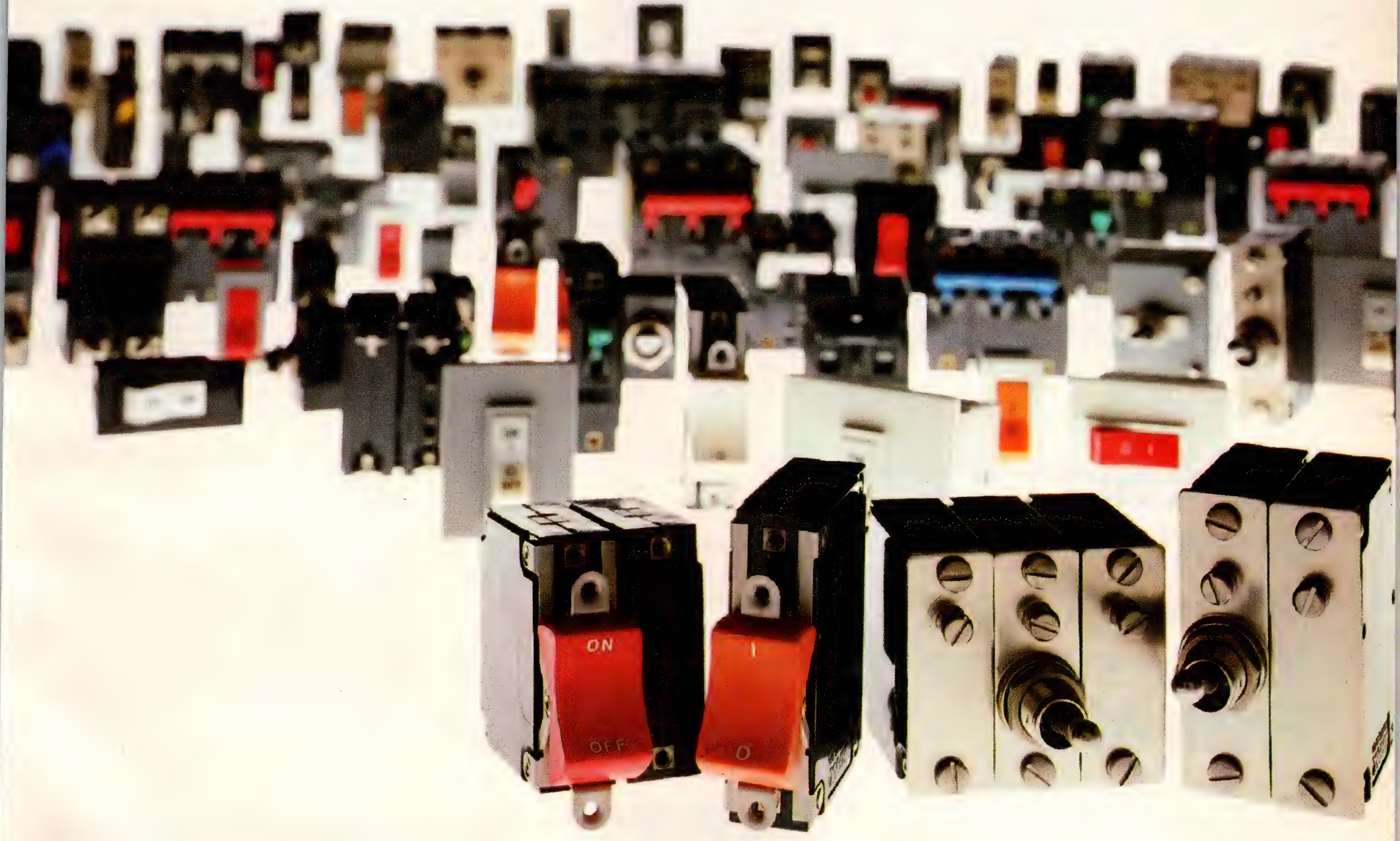
EDN

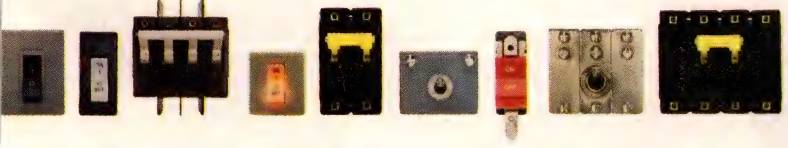
THERE ARE LOTS OF REASONS TO SPECIFY OUR BREAKERS. YOU'RE LOOKING AT THE FOUR NEWEST.

When specifying circuit breakers, protection is not the only consideration. Because different applications require different features, we introduce four exciting new products to the most comprehensive line of magnetic circuit breakers in the world.

International spacing and appealing design are combined in our new G and L Series circuit breakers with X-style handle. The L version is the first 50 amp breaker ever to sport an attractive rocker handle. Both versions combine on/off switching with circuit protection in one device. Attractive enough to mount up front, X-style breakers save real estate and eliminate the need to stock and install multiple components. They comply with VDE spacing requirements and are available in one- to four-pole models, 0.050 to 50 amps, with white, grey, black, orange or red handles. The beauty of N-style breakers (also available in G and L Series) lies in their ability to withstand harsh environments by providing waterproof panel integrity. The L Series is the first 50 amp frame size breaker with this benefit. Models are available in one- to three-poles, 0.050 to 50 amps.

Call us today with your specifications. Airpax Corporation, Cambridge Division, Woods Road, Box 520, Cambridge, MD 21613. (301) 228-4600. A North American Philips Company.





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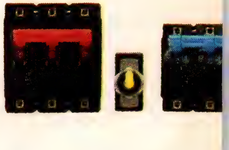

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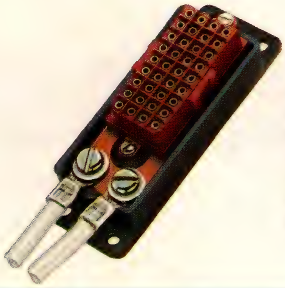
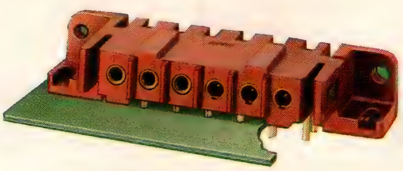
AMP Interconnecting ideas



Power distribution module, in full-bus or split-bus styles, handles up to 155 amperes. Data Bus and Drawer Connectors also available.



Your choice of coax, signal, and power mix in pcb headers.

CIRCLE NO 77

CABLE JACKETS

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Zippertubing Co, Box 61129, Los Angeles, CA 90061. Phone (213) 321-3901. TWX 910-346-6713.

Circle No 565

RS-232C ADAPTER

The Symbex RS-232C adapter is a cable interface device that lets you change the pinout of a connector or reverse its gender. The adapters fully comply with FCC shielding requirements through the use of zinc die-cast components for both the pin guard and the cover. The body is 0.915 in. long and includes a spring clip for ground connections. Adapter configurations include standard male-to-male and female-to-female gender changers and pinout adapters for standard null modem, semi-null modem, full-handshake null modem, and no-handshake null modem requirements. Other configurations are available on request. $8.99 (2500).

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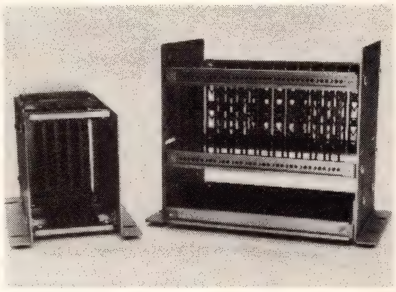

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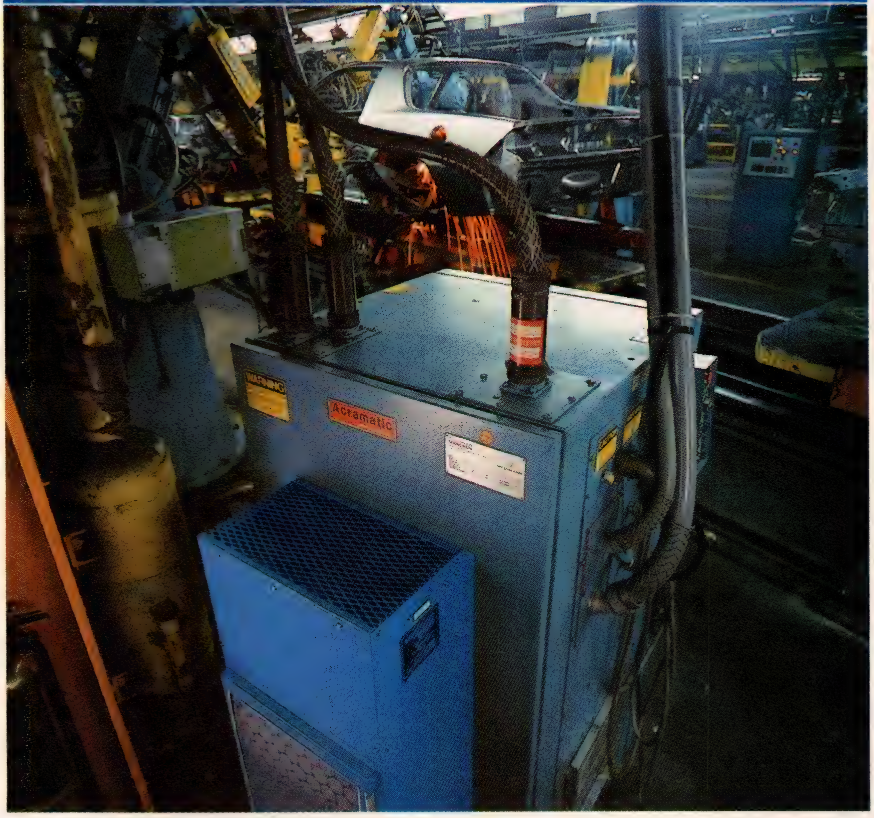

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CIRCLE NO 204

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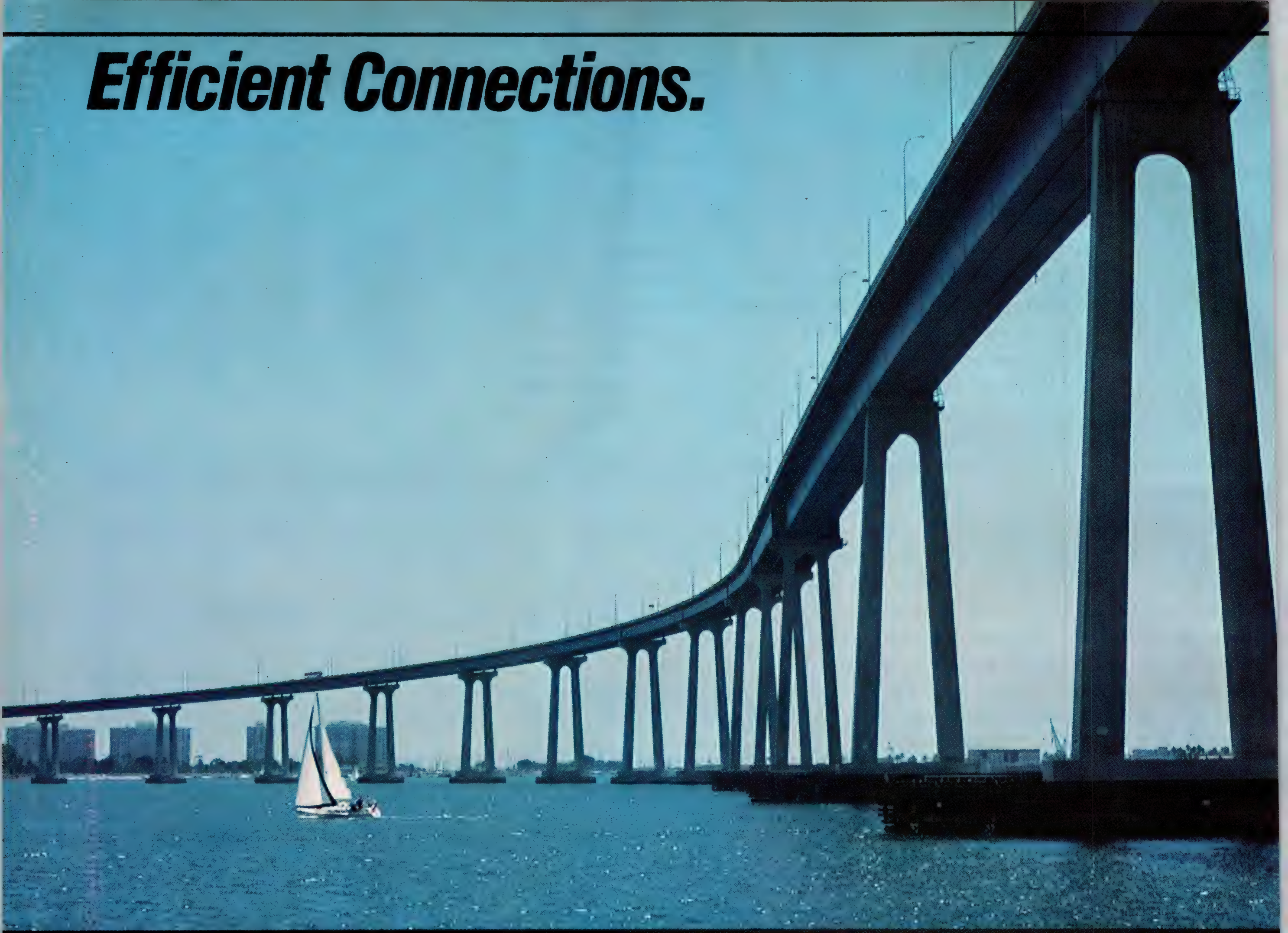

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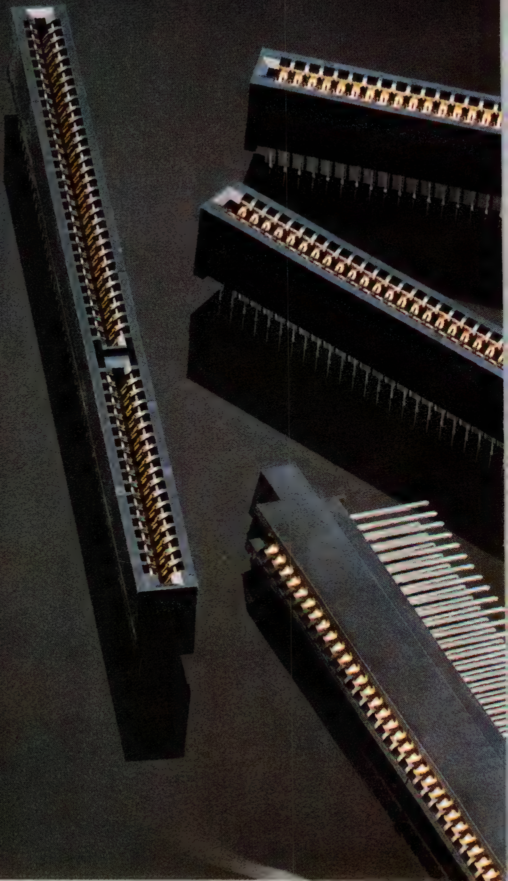

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CIRCLE NO 191

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provided for convenience. Each of the mother boards (the 4-slot BP-300, the 6-slot BP-500, the 8-slot BP-400, or the 12-slot BP-600) is available by itself or mounted in a gold-iridited aluminum card cage.

Card cages include antivibration, shock-dampening card guides, which have an open design to allow a free flow of air for cooling. Card cages with mother boards are available in side- or rear-mounting styles; 19-in. rack-mount cages are also available. BP-300, $89; BP-300 with card cage, $139.

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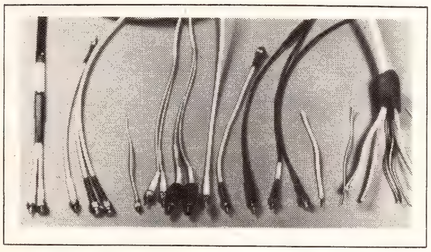
Circle No 560



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You can specify the fiber-core size, type of buffer, cable and connector, cable attenuation, the manufacturer of cable and connector, and, if needed, a breakout kit. With quantity orders, you can specify molded-on strain reliefs for the SMA connectors. Installed connectors (one end): SMA, $40; Optimate, $30; Biconic, $60.

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CIRCLE NO 10

DESIGN IDEAS

EDITED BY TARLTON FLEMING

Three ICs form portable RF burst generator

Steve Rickman
GE Medical Systems, Rancho Cordova, CA

Powered by a 9V battery, **Fig 1**'s circuit lets you generate low-level RF bursts having frequencies as high as 10 MHz, thus permitting field testing of high-frequency receivers. A jumper-selectable binary fraction (½ to 1⁄256) of the Y_1 crystal's frequency gates the output RF signal. Output amplitude (open circuit) is approximately 100 mV; output impedance is approximately 49Ω.

The circuit makes use of the low power and symmetrical output characteristics of 74HC logic. The RF source is a clock oscillator based on a 3.58-MHz color-burst crystal and two inverting buffers. Although the oscillator will operate with any crystal frequency of 1 to 10 MHz, you may need to add 15 pF across R_4 for frequencies above 4 MHz. C_3 and C_4 should each be twice the crystal's specified load capacitance.

The oscillator drives two cascaded 4-bit binary counters (IC_2), and the Sync signal resets the counters with a logic-high pulse (logic low at the counters). You select the desired output frequency by adding a jumper to one of the counter's eight output lines, which provides an enable signal for the two 3-state output buffers.

The square-wave output at IC_1, pin 11, is attenuated by R_1, R_2, and R_3 to fix the output resistance at approximately 49Ω. Further, a lowpass π network (C_1, L_1, and C_2) filters the square wave to produce a clean sine-wave RF output with THD of 2% or less. If you change the crystal frequency, you must change the filter's component values, but you can eliminate the filter altogether if harmonics aren't a concern.

Resistor R_3 is the only critical component. For clean gating, you should isolate it from the rest of the circuit. Ideally, you should build the circuit over a ground plane, place it in a metal box, and use a 50Ω BNC feedthrough terminator for R_3. Battery drain is about 6 mA when using a 3.58-MHz crystal, allowing the 9V alkaline battery to operate continuously for 80 hours.

EDN

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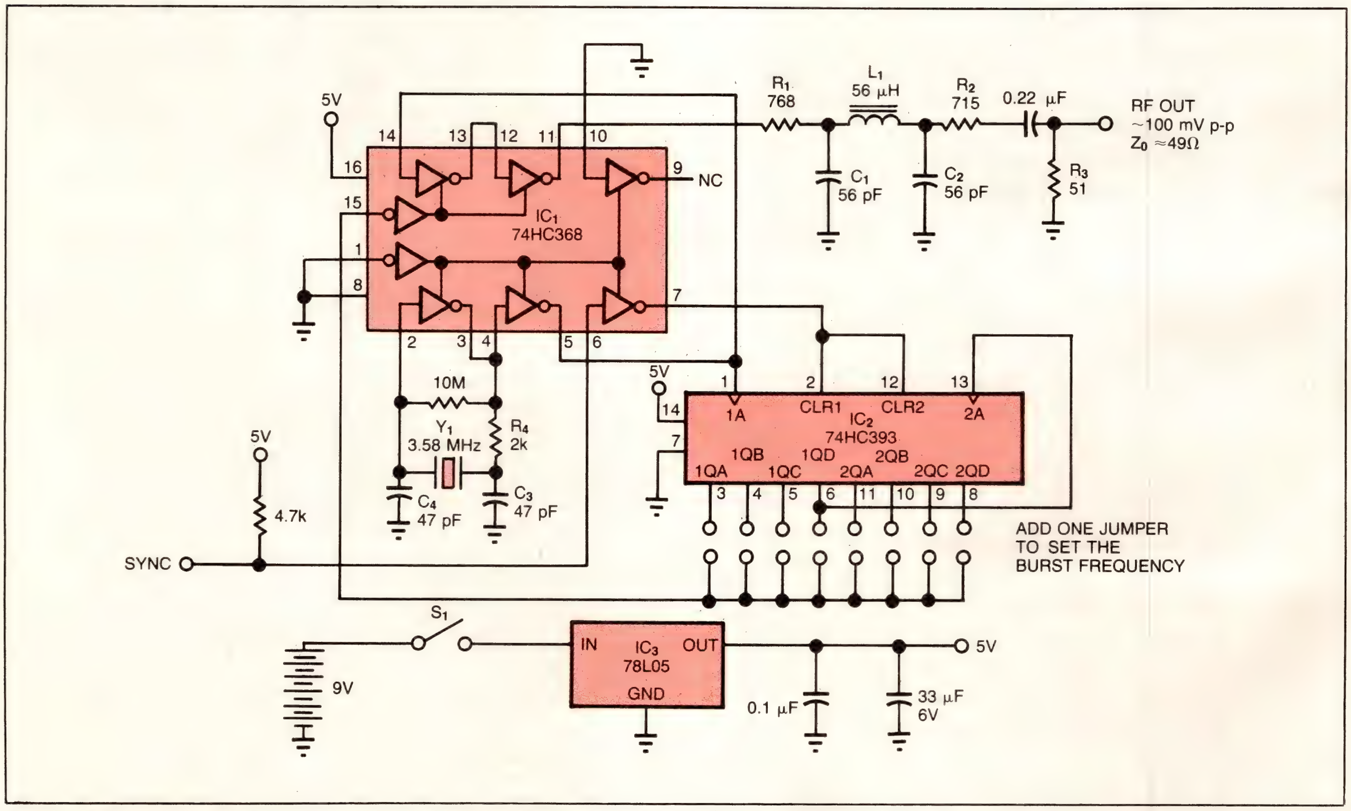

Fig 1—A low-power RF generator *provides bursts of RF at a jumper-selected submultiple (½ to 1⁄256) of the oscillator frequency. The output filter delivers an RF sine wave with less than 2% THD.*

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CIRCLE NO 156

Finite differences simplify look-up table

Sylvio Richard
*University of Sherbrooke, Sherbrooke,
Quebec, Canada*

As long as operating speed isn't of major concern in your application, you can reduce the size of your look-up table by storing finite differences rather than the function itself. The difference between two successive points on a function is generally slight; thus, fewer bits are required to store the difference than to store two values for a given resolution. Moreover, if the function is monotonic, you can further simplify the logic required for realization in uncommitted logic arrays, PLAs, and custom VLSI devices.

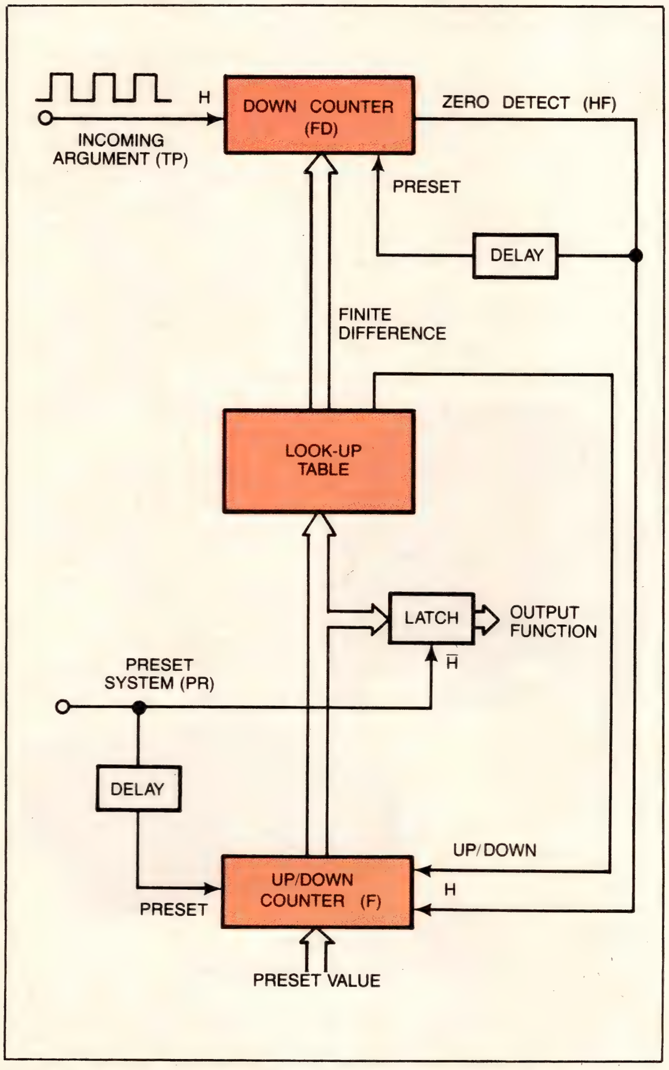

***Fig 1—You can reduce the size** of a silicon-based look-up table by storing finite differences instead of the function itself.*

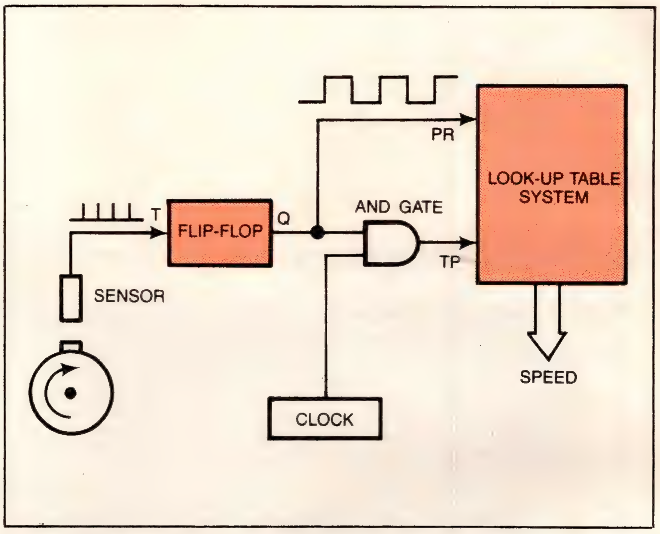

***Fig 2—This speed indicator uses a look-up table** of finite differences to convert from period to speed (rpm) information.*

First, attach two binary counters to the look-up table: A down counter represents the function difference (FD) for the finite differences, and an up/down counter represents the function (F) **(Fig 1).** For each value of F, the table generates a corresponding finite difference, which presets the down counter. If the value *n* of the argument of the function is given as a train of n pulses used to clock the down counter, then the preset value will decrease to zero and generate a pulse (HF) to increment or decrement the up/down counter. Then, the look-up table generates a new finite-difference value, and the cycle repeats for each additional incoming pulse. Provided you initiate the counters properly, the up/down counter will contain the function value when the incoming pulse train ends.

This scheme is suitable for period-to-frequency converters used in speed indicators **(Fig 2).** In this application, pulses from the sensor produce a square wave at the flip-flop's Q output. The AND gate conjoins this square wave with the output of an independent, high-frequency clock to produce pulse trains at TP. Each train consists of n pulses, where n (the argument of the speed function) is proportional to the period of the sensor signal. The square wave PR initializes the look-up table system on each rising edge and latches a result on each falling edge. You must choose a clock frequency such that the system can complete its speed computation during the interval between the two edges. **EDN**

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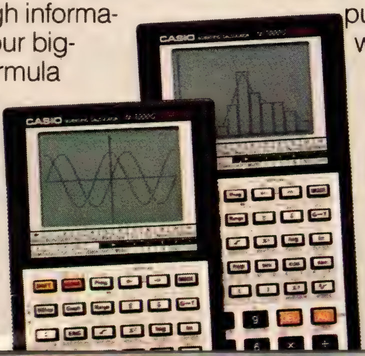

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CIRCLE NO 95

Circuit offers precision chopper control

Andrei Silard and Barna Kosa
Polytechnic Institute, Bucharest, Romania

The control circuit in **Fig 1** acts as an spst switch between terminals A and B, providing base (or gate) drive for chopper circuits using power npn transistors or gate-turn-off (GTO) thyristors. Potentiometers R_2 and R_3 allow independent adjustment of output frequency and duty cycle.

The current mirror, consisting of Q_1 and Q_2, charges capacitor C_1 at a rate determined by R_2's value, thus producing a linear voltage ramp. The output of comparator IC_2 remains low until the ramp voltage exceeds V_{REF}. You set this threshold by adjusting R_3. When the comparator output is low, thyristor Q_5 is on; when the output is high, the thyristor is off. For the components shown, you can set the output frequency range from 2 to 13 kHz by adjusting R_2. The relation is $F=3\times I/C_1(V_{CC}-V_{EE})$, where I is the charging current into C_1.

EDN

To Vote For This Design, Circle No 748

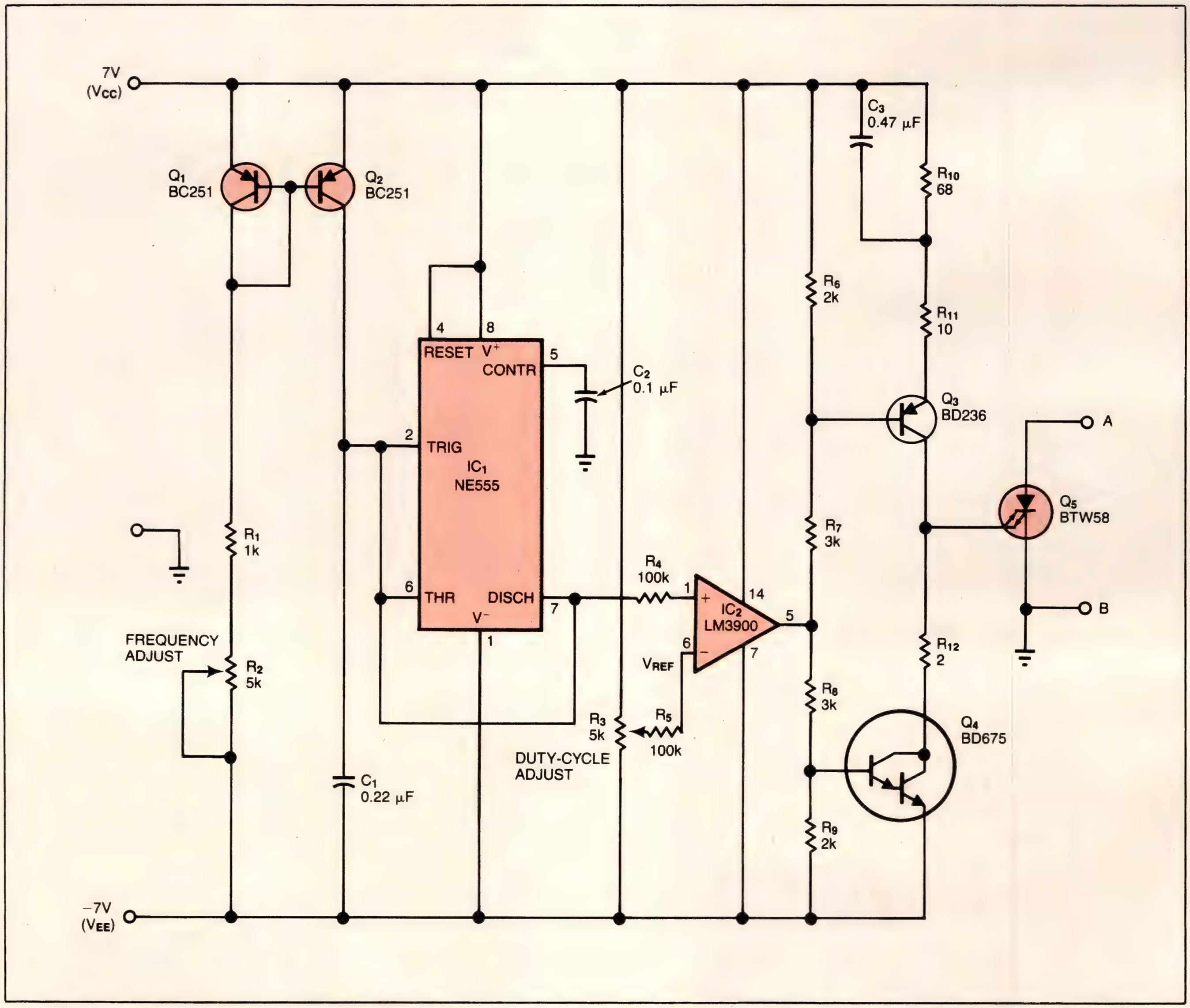

Fig 1—With this chopper control circuit, *you can perform independent adjustments: Potentiometer R_2 controls output frequency, and R_3 controls duty cycle.*

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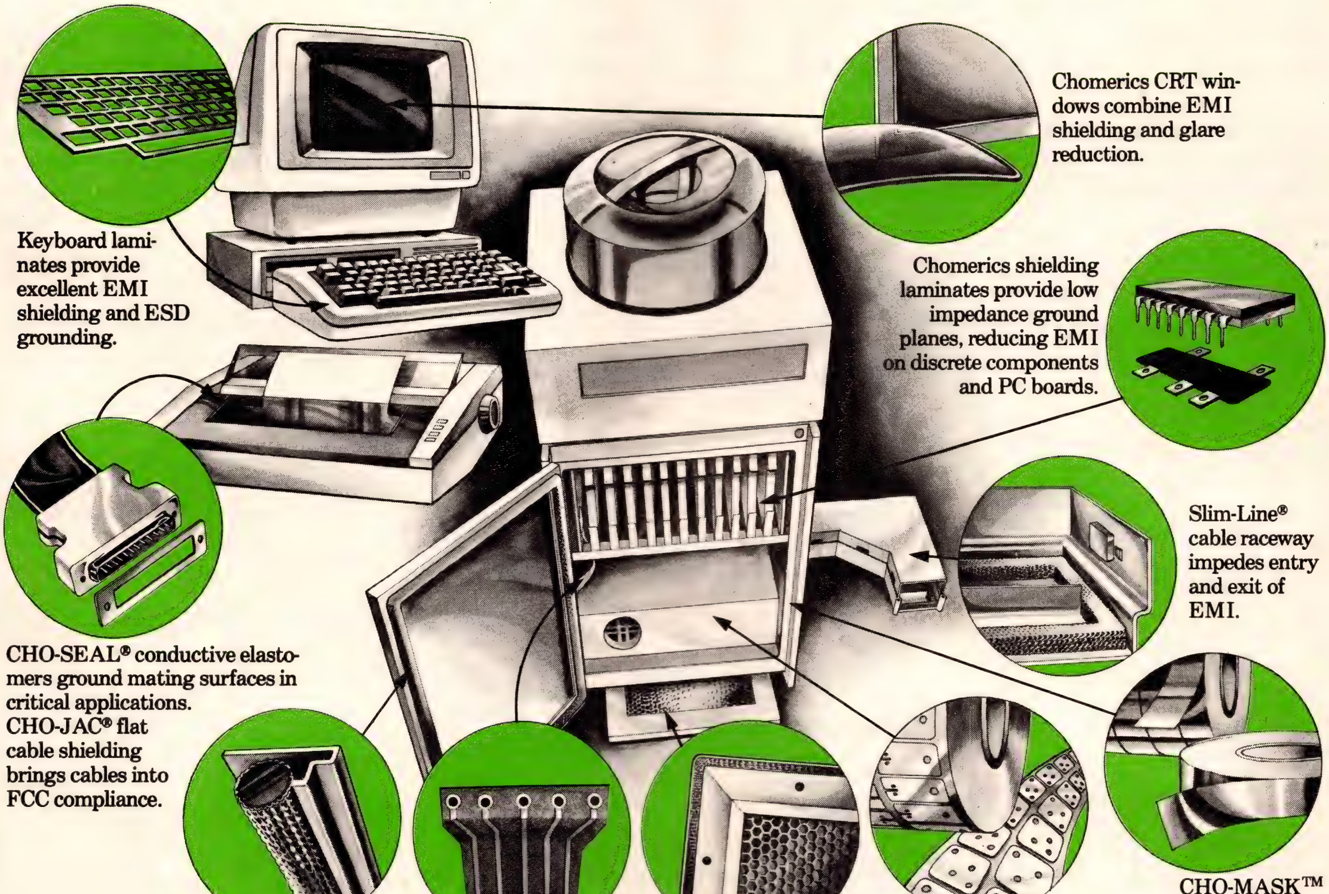

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CIRCLE NO 96

Low-power RS-232C driver operates from 5V

Mark Walczak
Microcontrol Pty Ltd, Monterey, Australia

The circuit in **Fig 1** draws only 4 mA from a 5V supply while driving a standard RS-232C receiver. In contrast, a 1488 quad-driver IC draws 10 to 20 mA from each of its two supplies.

The system clock drives a dc/dc converter that produces −3.4V. Frequency can range from 0.5 to 8 MHz, but a range of 0.5 to 1 MHz will minimize power dissipation. The circuit output withstands direct shorts to ground or to either of the supplies (±12V max). In place of the 74HC04 high-speed CMOS driver shown, you may want to substitute miscellaneous spare gates; one noninverting buffer, for example, can replace the two inverting types that receive the UART signal.

EDN

To Vote For This Design, Circle No 747

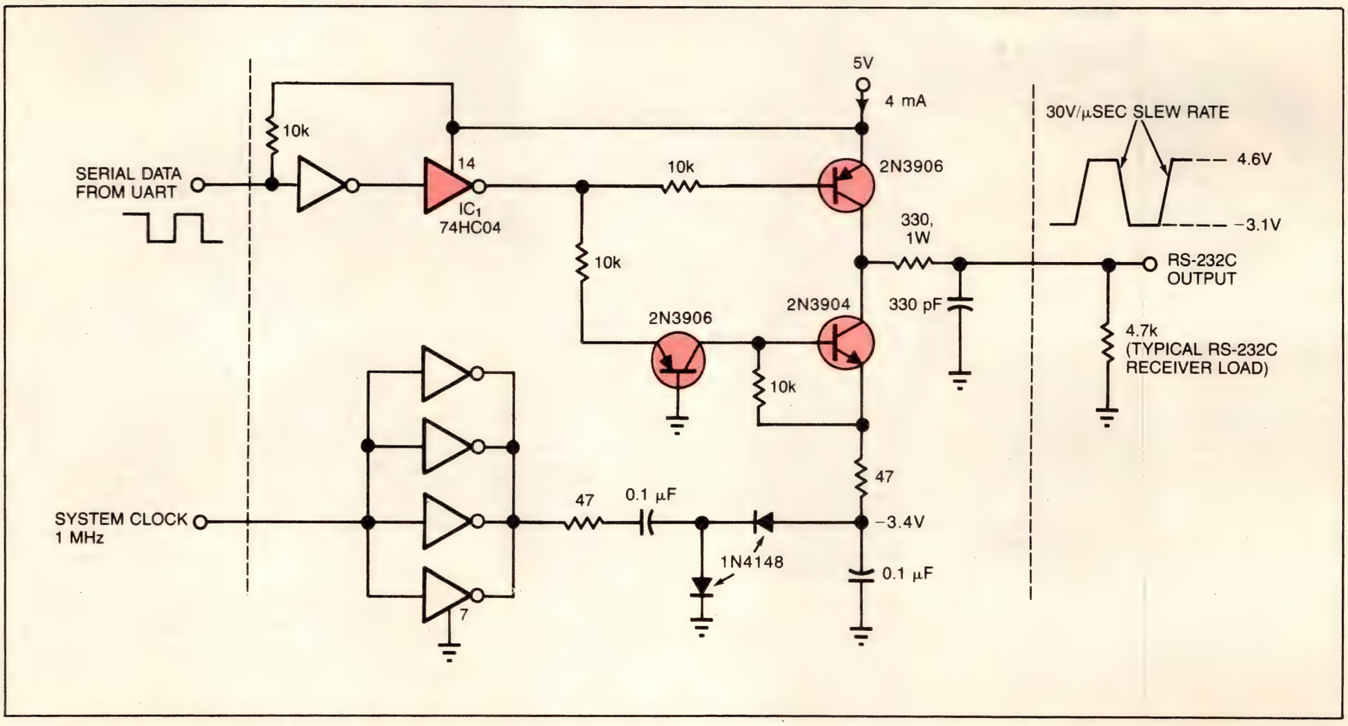

***Fig 1—You can build an RS-232C driver** using a CMOS IC and three transistors. Power consumption is 20 mW.*

Timer IC provides low-power voltage monitor

John J O'Farrell
The Tran-Trol Co, Tallahassee, FL

A CMOS version of the familiar 555 timer **(Fig 1)** can monitor battery voltages in the 2 to 15V range while drawing little current (less than 80 µA at 12V, for example). The alarm trigger is based on the nonlinear variation of the CMOS version's pin 5 voltage with respect to changes in the V^+ supply. The output normally equals V^+, but drops to 0V (RET potential) when V^+ falls below a threshold value. Moreover, an on-chip comparator controls the output, and separate resistive dividers bias each of the comparator's inputs.

An external divider (R_1, R_2, and R_3), whose variation with regard to V^+ is small, negative, and linear, biases the noninverting input **(Fig 2)**. An internal divider whose variation with respect to V^+ is large, negative, and nonlinear, on the other hand, biases the comparator's inverting input (pin 5). (The bipolar 555's pin 5 variation, by comparison, is small, positive, and linear.) Consequently, you can set the potentiometer R_2 to provide a small bias between the comparator's inputs—say, −100 mV. Then, different rates of change at pins 5 and 6 will reduce the bias as V^+ falls and will cause the comparator to trip near 0V bias.

Fig 1's waveforms illustrate the voltage monitor's operation. Pin 7 (DS, or discharge) is an open-drain output that acts simultaneously with pin 3 and that is suitable for driving an LED or other alarm indicator as shown. The alarm will remain on until you reset it manually via a pushbutton switch; or you can connect the autoreset resistor R_T, which resets the circuit following an interval, $T=1.1R_TC_T$. The alarm will promptly reactivate, of course, unless V^+ has risen above its trip level.

To calibrate the monitor, set V^+ at the desired

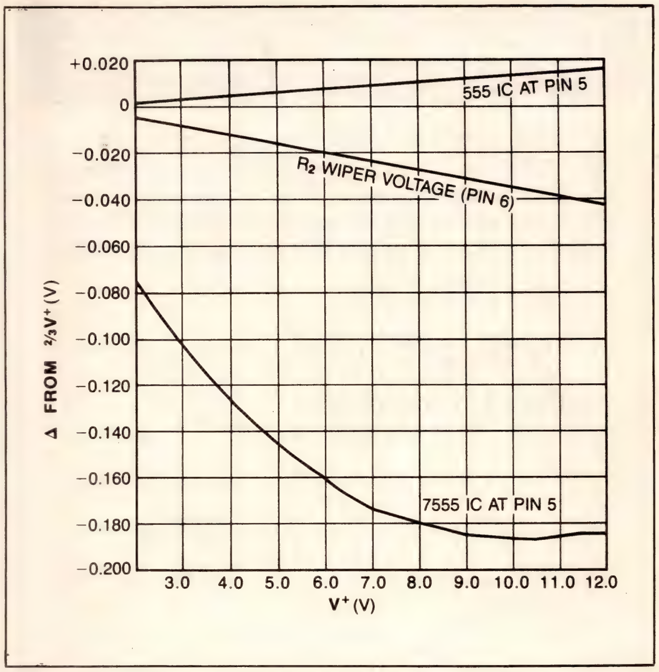

*Fig 2—**The alarm circuit in Fig 1 trips because** as V^+ decreases, the different rates of voltage variation at pin 5 and at pin 6 (the R_2 wiper) reduce the voltage between an internal comparator's terminals until the comparator changes state.*

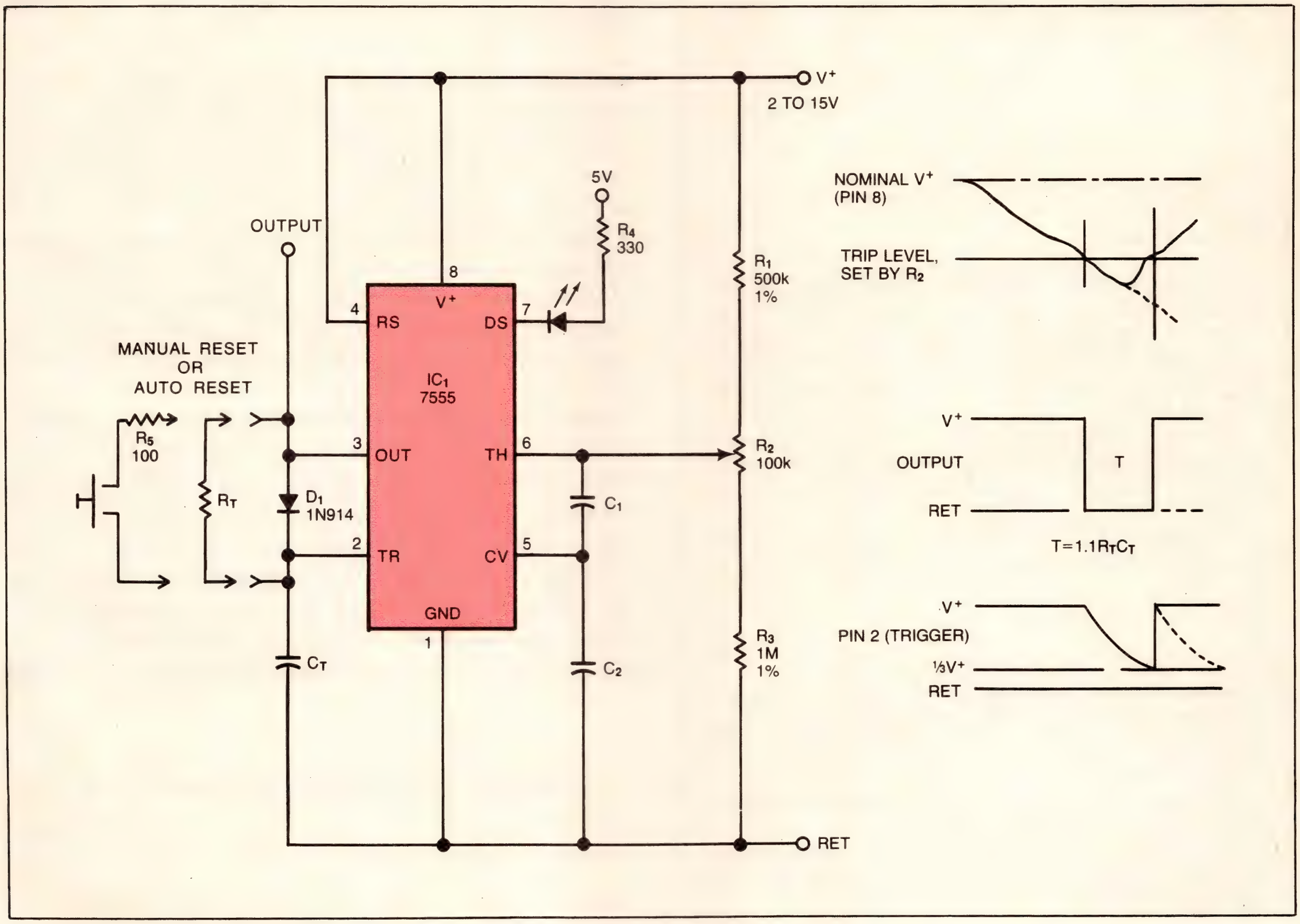

***Fig 1—A CMOS timer IC provides a low-voltage alarm** with an adjustable trip threshold.*

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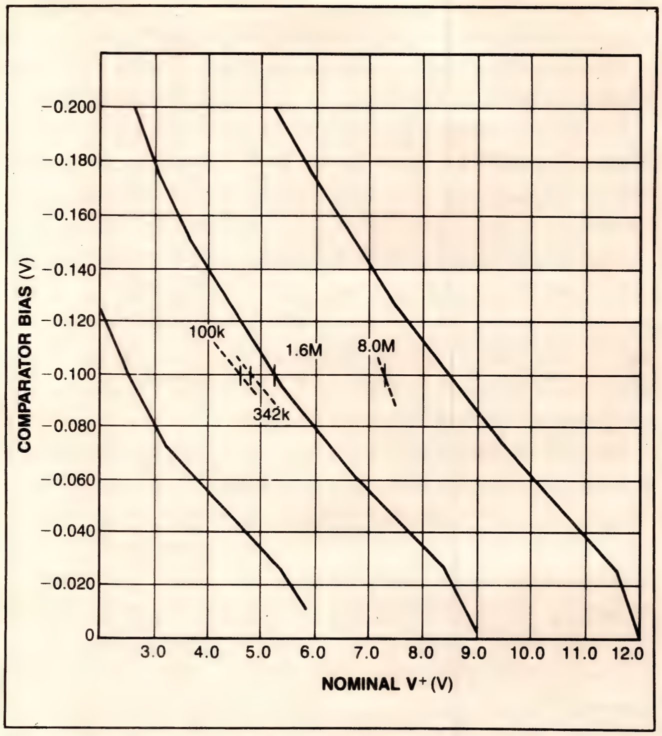

Fig 3—For three values of normal operating supply voltage, *you can predict the approximate threshold at which* ***Fig 1's*** *circuit will trip as V^+ decreases. Resistor values should be high to minimize power dissipation.*

minimum level and adjust R_2 until the alarm just trips. Then, return V^+ to its nominal level for normal operation. **Fig 3** illustrates the performance of the voltage monitor. If, for example, the nominal V^+ is 9V and you adjust R_2 for a comparator bias of −0.08V (ie, pin 6 voltage with respect to pin 5 voltage), then the alarm will trip at approximately 6V. R_3 should be half the size of R_1 to obtain the maximum adjustment range at the wiper of R_2. C_1 and C_2 suppress the alarm's response to noise in the V^+ supply; values should be less than 0.005 μF.

The voltage-monitor circuit depends on the nonguaranteed, nonlinear characteristic of the CMOS timer; in most timer applications, however, the CMOS version's nonlinear characteristic is of no consequence. Further, the variation of comparator bias with respect to temperature will depend only on the internal divider if you use metal-film resistors in the external divider. Published specs indicate the bias will change less than 1% over the IC's operating temperature range. **EDN**

To Vote For This Design, Circle No 746

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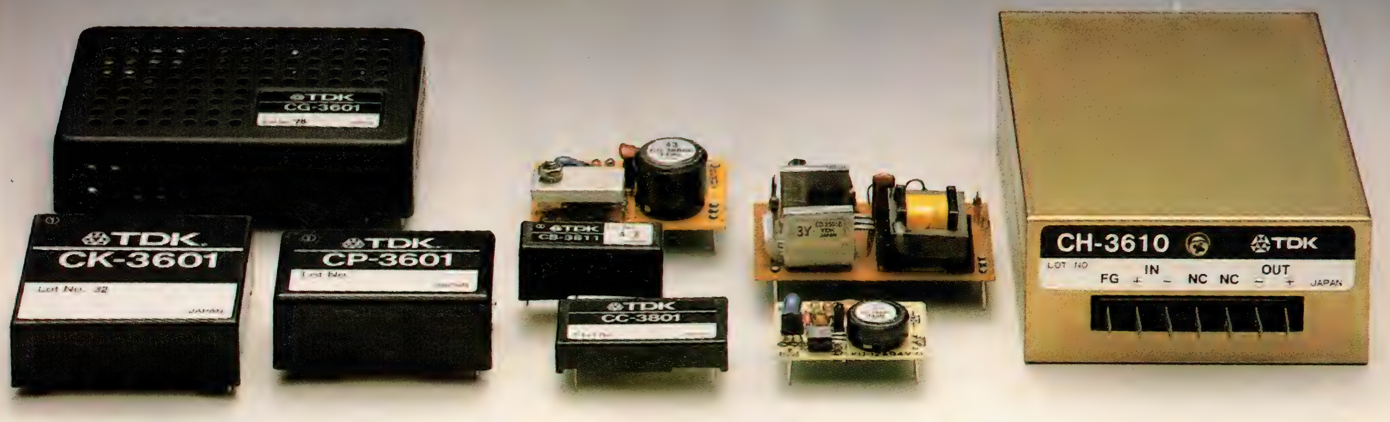


Now you can have accurately dosed DC power precisely where it's needed—right on the board—from three new ranges of TDK DC to DC converters. The 800mW CN series. The 1.5W CAK series. And the 3W CAM series.

All are based on TDK's expertise in high performance magnetic materials and use proprietary TDK circuits to achieve high efficiency and excellent output voltage stability. Using highly reliable ceramic capacitors instead of the usual electrolytics, the CAK and CAM series boast a particularly long service life with 1 million hours MTBF and a failure ratio of 1000 FIT.

CN series converters are 12mm in thickness and suitable for 3/4 inch racks. The CAK and CAM series are only 10mm thick to allow extra slim board construction. For specialized needs, talk to TDK about custom solutions. In any event, TDK quality will have you convinced. Or converted.

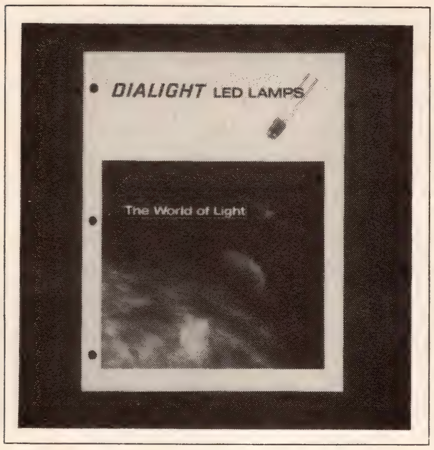
SPECIFICATIONS

Series	Output Power (W)	Input-Output Isolation	Dimensions (mm)	Input Voltage (V)	Output Voltage (V)
CB	0.3	No isolation	30.5×13.3×12.2	+4 to +7	−5
				±3 to +7	+12, +15, −15, −12
CC	0.25	No isolation	35.5×20×6.55	+5 ±5%	+12, +15, −15, −12, −5
CP	1.5	Isolation (CP-36, CP-46) No isolation (others)	45×30.5×16.5	5 ±10%	5, 9, 12, 15, ±12, ±15
				12 ±10%	5, 9, 12, 15, ±12, ±15
				24 ±10%	5, 9, 12, 15, ±12, ±15
				±4.5 to +12	±12, ±15, −17, −15, −12, −9
				+10.8 to +28.8	±12, ±15, −17, −15, −12, −9
CK	3	Isolation	47×47×14.5	5 ±10%	5, 12, 15
				12 ±10%	5, 12, 15
				24 ±10%	5, 12, 15
CG	6.6	Isolation	78×60×19	5 ±10%	5, 6, 12, 15
CH	10	Isolation	98×70×32	5 ±10%	5, 12, 15
CN NEW	0.8	No isolation	30.5×25.4×12	5 ±10%	12, 15, −15, −12, −5
				12 ±10%	5, −15, −12, −5
				24 ±5%	5 −15, −12, −5
CAK NEW	1.5	Isolation	40.5×25.4×9	5 ±10%	±12, ±15
				12 ±10%	±12, ±15
				24 ±10%	±12, ±15
CAM NEW	3	Isolation	46.5×37.5×10	5 ±10%	±12, ±15
				12 ±10%	±12, ±15
				24 ±10%	±12, ±15
				48 ±10%	±12, ±15
CD Series for driving fluorescent display	Up to 6	No isolation	32×24×8.5~10 43×31×15~18 51×34×20	–	Products are made in accordance with fluorescent displays.

TDK®

TDK CORPORATION OF AMERICA HEAD OFFICE 4711 West Golf Road, Skokie, IL 60076, U.S.A. Phone: (312) 679-8200 Telex: 9102230220 (TDK SKO) **CHICAGO REGIONAL OFFICE** 4711 West Golf Road, Skokie, IL 60076 Phone: (312) 679-8200 Telex: 9102230220 (TDK SKO) **INDIANAPOLIS REGIONAL OFFICE** 4015 West Vincennes Road, Indianapolis, IN 46268 Phone: (317) 872-0370 **LOS ANGELES REGIONAL OFFICE** 3102 Kashiwa Street, Torrance, CA 90505 Phone: (213) 539-6631 Telex: 9103496968 **NEW YORK REGIONAL OFFICE** 12 Harbor Park Drive, Port Washington, NY 11050 Phone: (516) 625-0100 Telex: 144535 (TDK ELECT GRCY) **DETROIT DISTRICT OFFICE** 3000 Town Center, Suite 2239, Southfield, MI 48075 Phone: (313) 353-9393 **HUNTSVILLE DISTRICT OFFICE** 303 Williams, Suite 1032, Huntsville, AL 35801 Phone: (205) 539-4551 **SAN FRANCISCO DISTRICT OFFICE** 2254 North First Street, San Jose, CA 95131 Phone: (408) 435-8565 **GREENSBORO DISTRICT OFFICE** 620 Green Valley Road, Suite 302, Greensboro, NC 27408 Phone: (919) 292-0012 **TDK CORPORATION.** TOKYO, JAPAN.

CIRCLE NO 155



Flyer describes LED offerings

This 12-page flyer describes the discrete LED indicators that the manufacturer supplies in T-1¾, T-1, and T-¾ packages as well as LEDs available in rectangular and special packages. The product line includes red, yellow, and green LEDs as well as bicolor and tricolor devices. Data provided for each type of LED includes wavelength, forward voltage, typical luminous intensity, and test conditions. The manufacturer also provides mechanical drawings for the LED packages.

Dialight Corp, 203 Harrison Pl, Brooklyn, NY 11237.

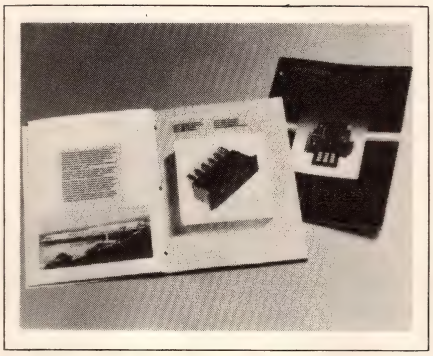
Circle No 433

Catalog features resistor and capacitor networks

Featuring resistor, capacitor, and RC networks, this 42-page catalog includes specifications for standard products as well as surface-mount, military, and custom networks. The catalog covers uncommitted components and combinations of components in termination networks. Data sheets for each type of product include electrical specifications along with environmental and physical characteristics. The electrical specifications include component value, tolerance, and temperature coefficient. Data sheets also furnish a dimensioned mechanical drawing for each part.

Sprague Electric Co, Marketing Communications Dept, Box 9102, Mansfield, MA 02048.

Circle No 434



Flyer details keyboards and thumbwheel switches

This brochure includes engineering data on the manufacturer's Digiswitch, Minilever, Digivider, and Digidecade thumbwheel switches as well as its Minikey keyboards. Truth tables, option charts, layout drawings, and engineering parameters are included. The information also contains a comprehensive guide to military and commercial switch selection.

Digitran, 3100 New York Dr, Pasadena, CA 91107.

Circle No 437

Catalog describes relays

The 8600 catalog describes a wide range of relays, including general-purpose, latching, miniature, and high-power types. The catalog also provides information about special-purpose relays for voltage sensing and timing operations. Data for each relay type includes contact and coil specifications as well as general information about operating times, dielectric breakdown, weight, and available sockets. Besides the relay data sheets, the catalog provides a section that covers sockets, springs, and hold-down clips used to mount the relays.

Midland-Ross Corp, Midtex Div, Box 3328, North Mankato, MN 56001.

Circle No 435

Catalog details converter product lines

This 46-pg catalog, an overview of the company's data-acquisition and converter products, covers hybrid and IC converters, printers, panel meters, and plug-in data-acquisition boards. Tables delineate each product line for quick selection. The D/A- and A/D-converter tables include information about input and output signal formats and ranges,

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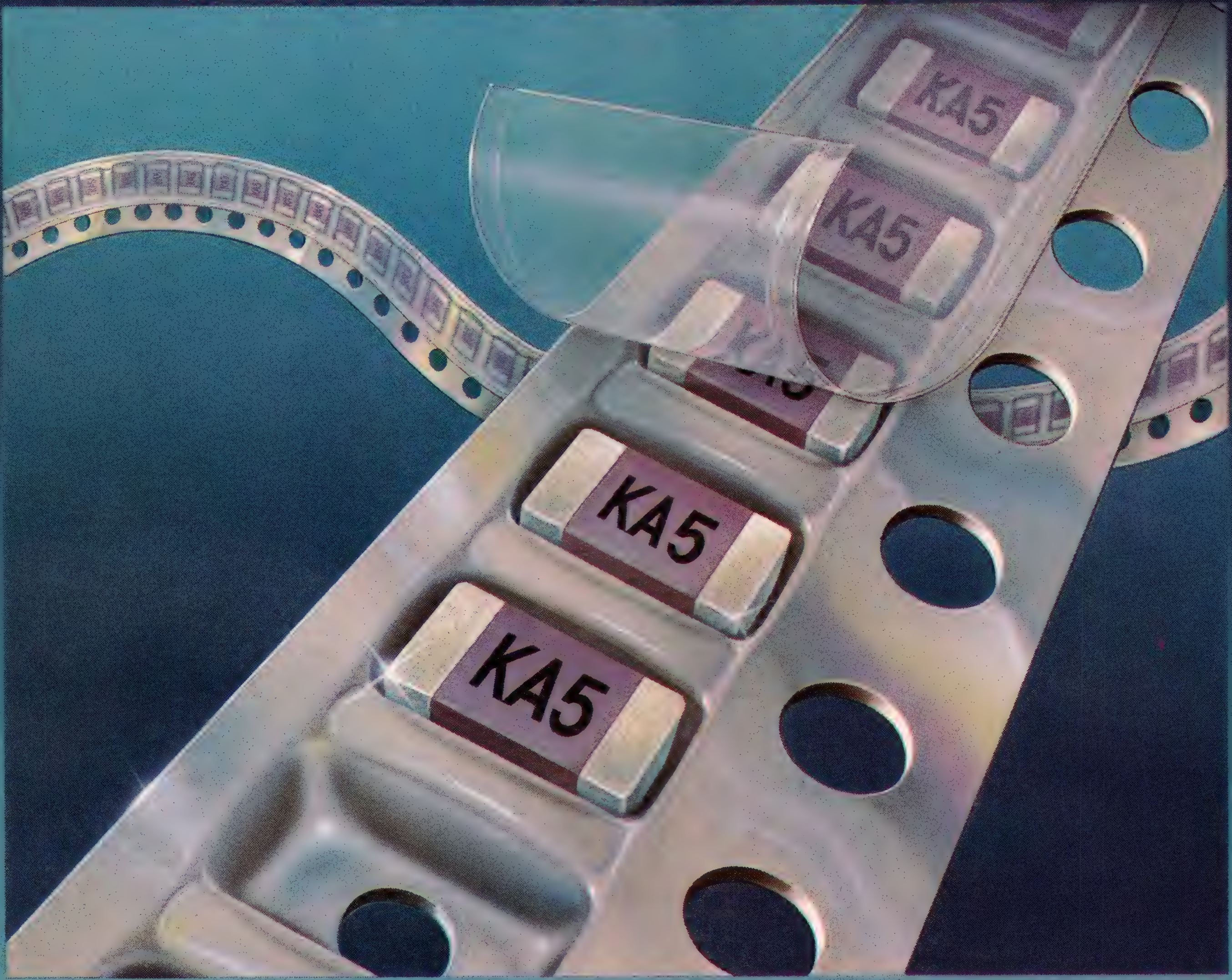

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It's high time someone developed chip packaging that works as fast as your fastest placement machines. So we did.

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Here's more innovation: cover tape with reduced pull variation from the carrier tape. Result: smoother machine feed, greater production efficiency.

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KEMET chips come in case sizes from C0805 through C2225, with capacitances of 1.0 pF to 2.2 μF and working voltages of 50 to 200 VDC. In standard grades meeting EIA RS198 specs…CDR grades meeting MIL-C-55681 performance…and in high-reliability GR900 grades.

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COMPONENTS DEPARTMENT

CIRCLE NO 154

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CIRCLE NO 153

resolution, and power requirements. You can fill out the literature request card to receive more detailed information directly from the manufacturer.

Datel, 11 Cabot Blvd, Mansfield, MA 02048.

Circle No 436

Brochure covers MIL-STD-1553 products

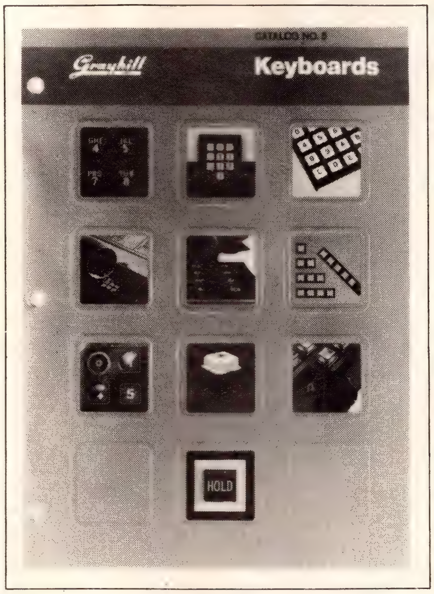
This 12-pg, 4-color brochure summarizes the company's products for the MIL-STD-1553 data bus. Among the products are bus controllers, remote terminal units, and bus monitors on industry-standard VME Bus, Unibus, and Multibus cards. Also presented are hybrid devices in 2×2-in. packages and building-block hybrids that let you produce any -1553 configuration. The manufacturer's test equipment, including a data-bus exerciser and a benchtop tester, is also covered.

ILC Data Devices Corp, 105 Wilbur Pl, Bohemia, NY 11716.

Circle No 438

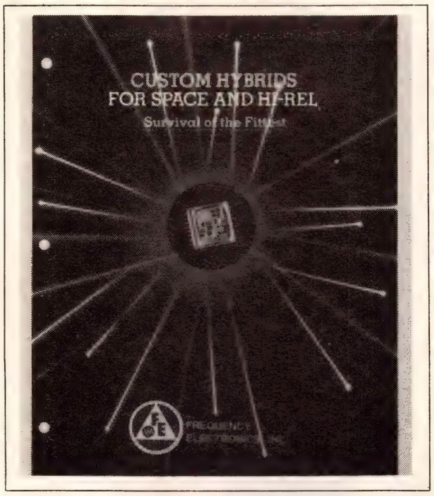
Catalog details keyboards

This 40-pg keyboard catalog features the manufacturer's line of dome and wiping-contact keyboards and keyboard modules. The full-color catalog provides engineering drawings, product specifications, and prices, along with keyboard features and legend options. Products covered include low-profile keyboards and stackable modules in several keypad styles. The keypads can be lighted; they are also available with graphic-overlay legends and printed or molded-in legends.



Grayhill Inc, 561 Hillgrove Ave, La Grange, IL 60525.

Circle No 439


CUSTOM HYBRIDS FOR SPACE AND HI-REL
Survival of the Fittest
FE
FREQUENCY ELECTRONICS, INC.

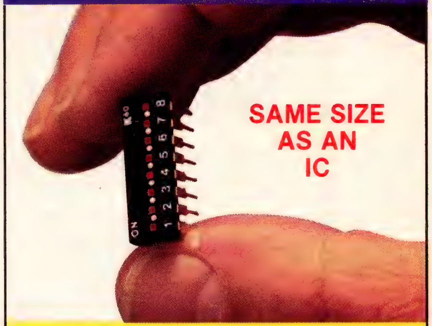
High-reliability custom hybrids covered

Custom Hybrids for Space and Hi-Rel: Survival of the Fittest is a 4-color brochure that describes the company's Class S and B custom-hybrid manufacturing capability. The hybrids use thick- and thin-film technologies to package circuits from dc to 22 GHz.

Frequency Electronics Inc, 55 Charles Lindbergh Blvd, Mitchel Field, NY 11553.

Circle No 440

WORLD'S SMALLEST DIP SWITCH



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CIRCLE NO 49

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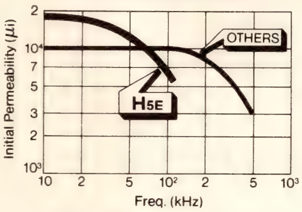
Next time you're in our neighborhood, come and take a look at the world's largest production of ferrite materials. TDK manufactures ferrite cores from the raw materials on up, with totally automated production systems. 50 years of experience and a continuous R & D program are reflected in unique features and unsurpassed quality levels.

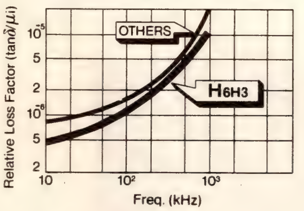
For telecom and power supply applications, TDK ferrite cores include:

- High permeability types such as our H5E
- Low loss types with significantly reduced loss factors up into the MHz range;
- Extremely low power loss and reduced temperature surge types (H7C4);
- TDK original cores, EEC, EP, LP and PQ as well as IEC standard core shapes including EEC, POT, RM, etc.

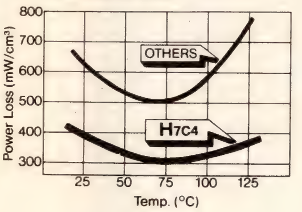
μi vs. Frequency Characteristics



tanδ/μi vs. Frequency Characteristics



Power Loss vs. Temp.



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CIRCLE NO 88

Microwave parts described

The manufacturer's line of microwave components, including coaxial and waveguide switches, dummy loads, and crystal detectors, are detailed in this 24-pg brochure. Also presented are bolometers and RF micropotentiometers. Among the coaxial switches described are high-frequency, high-power devices that spec 1M-cycle reliability. The company supplies waveguide switches for L band to KU band and three series of dummy loads (medium power, high power, and liquid cooled), as well as 50W coaxial miniature dummy loads.

Micronetics Inc, 36 Oak St, Norwood, NJ 07648.

Circle No 441

Revised handbook covers synchro-conversion topics

The 116-pg revised edition of the *Synchro Conversion Handbook* includes a new section that lists application notes and another new section that serves as a guide to the manufacturer's products. The hand-

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TECHNOLOGY UPDATE

LCD-driver/ controller ICs offer versatility in configuration and function

By Ed Teja,

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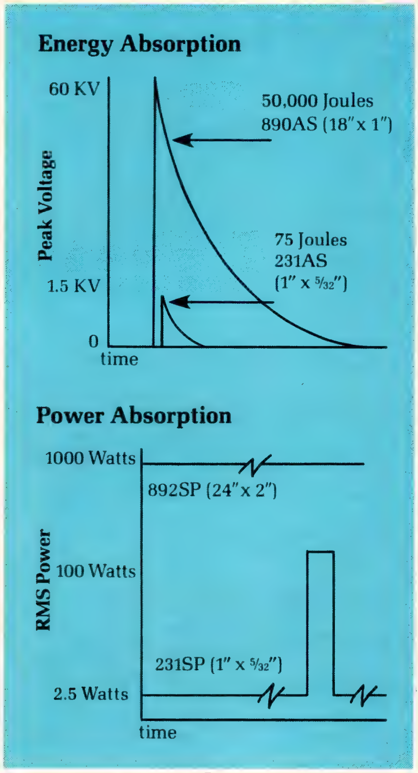

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CIRCLE NO 129

book covers such topics as the fundamentals of angle-sensing transducers and data-conversion devices, theory of operation, measuring and computing performance parameters, and design constraints and selection criteria. It acquaints you with the principles of synchro conversion and provides insights into the tradeoffs between different synchro-conversion methods.

ILC Data Device Corp, Marketing Dept, 105 Wilbur Pl, Bohemia, NY 11716.

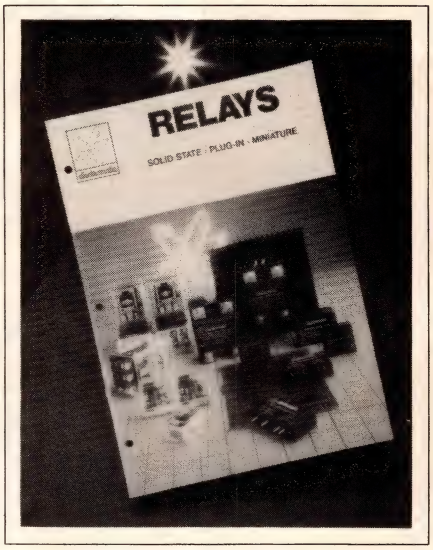
Circle No 444

Catalog helps you choose circuit-board indicator

An 8-pg LED circuit-board-indicator catalog lists the company's line of LEDs, which require no lead bending or trimming. The short-form catalog includes dimensional drawings as well as pertinent specifications so you can choose the proper LED circuit-board indicator. The catalog also lists the company's representatives.

Dialight Corp, 203 Harrison Pl, Brooklyn, NY 11237.

Circle No 442

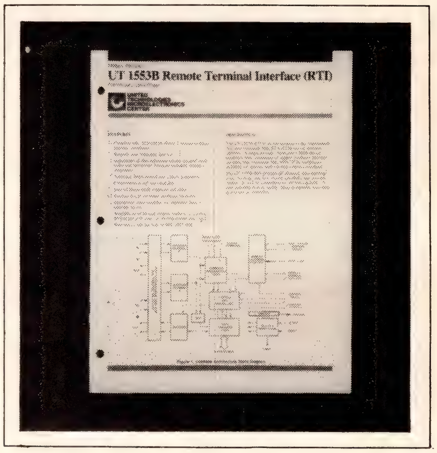


Relays and sockets featured in brochure

This 8-pg brochure features the manufacturer's line of solid-state, mechanical plug-in, and miniature pc-mount relays. The publication covers relays for horizontal and vertical pc-board or plug-in mounting, as well as snap-mount spade and octal-relay sockets. It lists the benefits of each type of relay and provides a relay-selection guide. Technical data is presented with tables, graphs, and diagrams.

Electromatic Controls Corp, 2495 Pembroke Ave, Hoffman Estates, IL 60195.

Circle No 443



Data sheet explores MIL-STD-1553 interface

This preliminary data sheet covers the manufacturer's MIL-STD-1553B remote-terminal interface, the UTI 1553B RTI. Through text, tables, and diagrams, the 20-pg publication covers interface features, electrical characteristics, the interface architecture, and a pinout description. It also includes sections on general information, transparent memory access, and the control reg-

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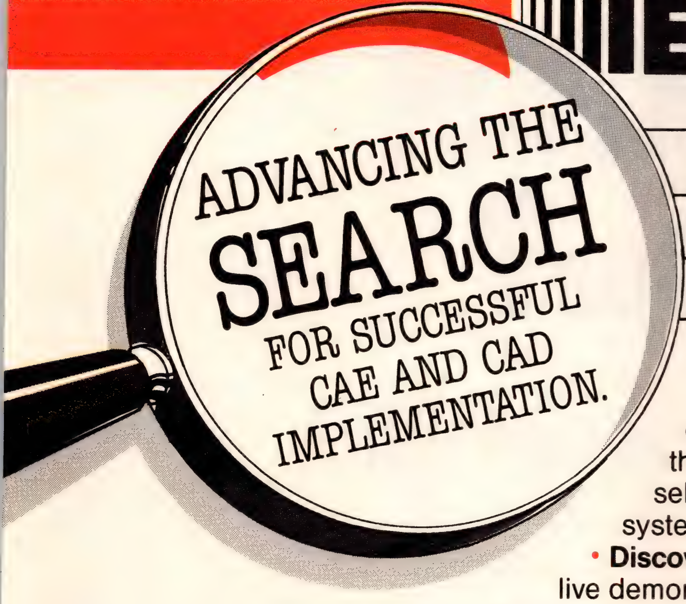

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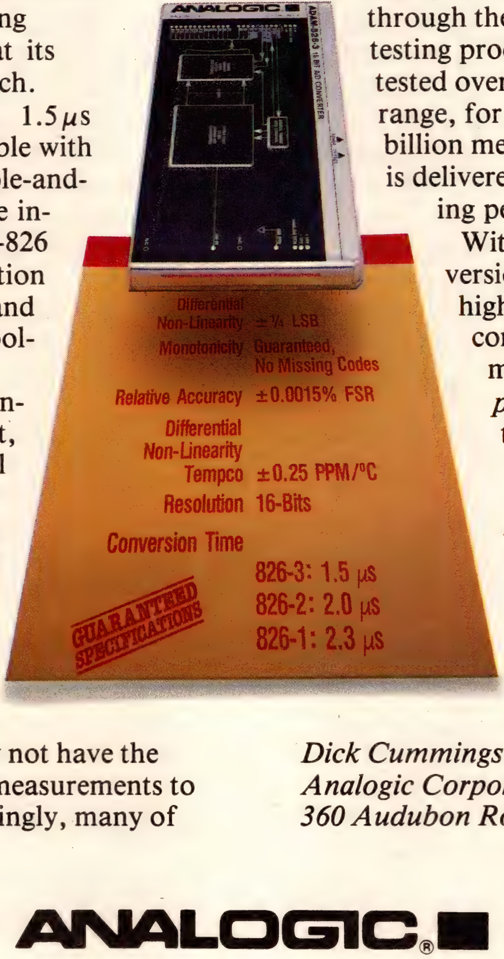
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Dick Cummings — (617) 246-0300
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360 Audubon Road, Wakefield, MA 01880

ANALOGIC®

CIRCLE NO 78

ister. In addition, it provides timing diagrams and outline diagrams. The pamphlet is 3-hole punched for loose-leaf filing.

United Technologies Microelectronics Ctr, 1575 Garden of the Gods Rd, Colorado Springs, CO 80907.

Circle No 445

APPLICATION NOTES
ILC DATA DEVICE CORPORATION
Hybrids take on power

App note covers power hybrids

This 4-pg application note describes the materials, packaging, and fabrication processes of the manufacturer's power hybrids. *Hybrids take on power* describes how these chip-and-wire devices have low thermal resistance from semiconductor junction to hybrid case, and how they have low electrical resistance in the circuit path. The note also shows how you can use power hybrids to minimize circuit size and weight.

ILC Data Device Corp, Marketing Dept, 105 Wilbur Pl, Bohemia, NY 11716.

Circle No 449

Catalog provides transformer specs

signal
TRANSFORMERS
PRONTO!

The 24-pg Catalog G85, *Transformers*, contains technical and specification details of the company's power transformers, including its international series. Illustrated with photographs, dimensional drawings, and exploded-construction views, the catalog also describes flat-head and miniature plug-in power transformers in both large-output and pc-board sizes. In addition, it covers filter chokes, dual chokes, step-down auto transformers, and power-isolation transformers. One section explains how to specify power-transformer and filter ratings.

Signal Transformer Co Inc, 500 Bayview Ave, Inwood, NY 11696.

Circle No 450

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For Military Applications with JANTX Specifications.

MCG Overvoltage Protectors isolate vehicle, marine, airborne or ground support system components from destructive DC overvoltages, by shunting the overvoltage around the sensitive circuits. The protectors then reset automatically.

The LVC-M series protectors are available from 6 to 36 volts, 55 to 235 amps, and they are designed to meet and exceed JANTX specifications. Call or write today for information.

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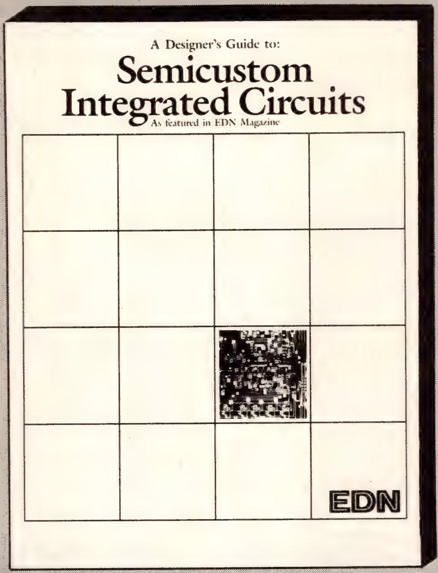

Learn how to design a semicustom IC with *A Designer's Guide to Semicustom Integrated Circuits.* Based on EDN's own design experience, this nine-chapter booklet outlines the complete procedure used to design, fabricate, and test EDN 1, a chip with a 1200 equivalent-gate complexity. You'll not only learn the steps to take when creating ICs, but also the design/cost analyses and vendor-interface methods that lead to successful semicustom chips.

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Selection guide features 4-phase stepper motors

Covering three types of 4-phase stepper motors, this 24-pg selection and application guide also contains information on the company's board-type driver circuits, pulse generators, and synchronous motors. The guide includes specs, typical torque-vs-pulse-rate characteristics, and schematics for PM-, HB-, and VR-type stepper motors. The board-type drivers described are designated the PS and BCD series. The pulse generators are those in the PLC-80K Series and the synchronous motors are designated the PTM Series. All products are produced by the Nippon Pulse Motor Co.

Kollmorgen Corp, Inland Motor Div, Stepper Products Group, 4020 E Inland Rd, Sierra Vista, AZ 85635.

Circle No 452

Hybrids characterized

This 8-pg color brochure introduces the manufacturer's hybrid products and manufacturing capabilities. It covers such standard hybrid products as resistor SIP devices and telephone-line and interface modules; custom hybrids are also covered.

Mitel Semiconductor, c/o Inquiry Management Systems, Box 911, Station U, Toronto, Ontario, Canada M8Z 9Z9.

Circle No 447

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Ten times a year EDN publishes *EDN Career News*, the fastest-growing newspaper focused solely on the career and professional development concerns of engineers in electronics.

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Potter & Brumfield A Siemens Company

8602

CIRCLE NO 205

VME Bus reference covers standards, products

This 6-pg designer's guide details VME Bus systems and standards along with selection criteria for both hardware and software products. It includes a summary of such typical VME Bus products as processors, memories, I/O devices, mass-storage units, and a variety of other parts. It also contains a 1-pg VME Bus primer.

Plessey Microsystems Inc, 1 Blue Hill Plaza, Pearl River, NY 10965.

Circle No 401

Catalog highlights DEC-compatible products

Covering Q Bus-, Unibus-, MicroVAX-, and VAX-compatible products, this catalog provides product prices, photographs, and operational/functional descriptions. The catalog describes advances in communications processing, multiplexing and data transmission, ultrahigh-speed mass-storage, and other memory-device controllers and subsystems. The book also covers the manufacturer's traditional product line of peripheral-device controllers, communications interfaces, general-purpose and foundation modules, interprocessor links, and bus switches.

MDB Systems Inc, 1995 N Batavia St, Orange, CA 92665.

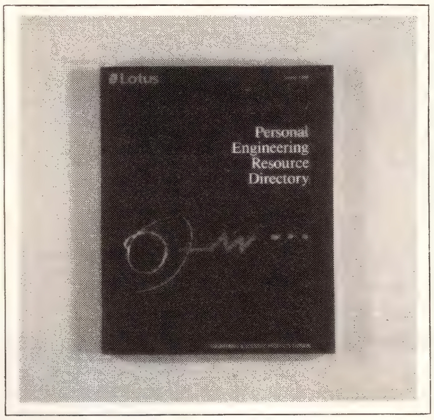
Circle No 402

Source book covers technology and standards

The *Data Communications Source Book*, a reference work in loose-leaf format with quarterly updates, covers all major aspects of data communications. The early chapters present the latest information on the legal and regulatory environment of data communications, a summary of the standards-making organizations in the USA and overseas, and explanations of the domestic and international standards these organizations have issued. Later chapters cover both hardware and software aspects of fiber-optics systems, networks, satellite systems, videotex systems, modems, terminals, multiplexers and concentrators, integrated voice/data equipment, and facsimile equipment. A chapter on network security discusses security problems in general, the data-encryption standard, and encryption/decryption products.

The Merritt Company, Box 955, Santa Monica, CA 90406.

Circle No 403



Directory surveys tools for IBM PC

The 132-pg *Personal Engineering Resource Directory* provides brief specifications of engineering tools that operate with the IBM PC, PC/XT, and PC/AT, and are mostly (but not exclusively) compatible with Lotus data-analysis tools. In addition to a section covering data-acquisition hardware and software, the directory has sections that list CAD/CAM software packages, geological and petrochemical packages, spreadsheet auditors, and statistical packages. The final 30 pages lists institutes that offer training for the manufacturer's products. Also included is a bibliography of books on those products and magazine articles relating to unusual applications of 1-2-3 and Symphony.

Lotus Development Corp, 55 Cambridge Pkwy, Cambridge, MA 02142.

Circle No 406

Bus products described

Containing short descriptions of more than 60 STD Bus and VME Bus μC boards, this industrial-control products catalog also covers support software, firmware, and hardware. The products, based on Z80, 8085, 68000, and 68008 μPs, include single-board computers, CPUs, memory devices, and I/O and communications devices. Also covered is the manufacturer's family of EPROM emulator/programmers. You can use the products in process- and industrial-control applications, ATE, and data-acquisition systems.

Micro-Link Corp, 14602 N US Hwy 31, Carmel, IN 46032.

Circle No 407

MIL-STD-1553 interface explored

This preliminary data sheet covers the manufacturer's MIL-STD-1553B remote-terminal interface, the UTI 1553B RTI. Through text, tables, and diagrams, the 20-pg publication covers interface features, electrical characteristics, the interface architecture, and a pinout description. It also includes sections on general information, transparent memory access, and the control register. In addition, it provides timing diagrams and outline diagrams. The pamphlet is 3-hole punched for loose-leaf filing.

United Technologies Microelectronics Ctr, 1575 Garden of the Gods Rd, Colorado Springs, CO 80907.

Circle No 408

VME Bus packaging highlighted

VMEbus Packaging and Interconnections is a 20-pg book that helps you advance VME Bus systems from logic and circuit design to the finished product. The book begins with an overview of VME Bus characteristics, features, and standards, and goes on to explain interconnection and packaging considerations and alternatives in terms of system performance. The book includes specs for card cages, backplanes, VME interconnect boards, and wire-wrapped circuit boards, as well as extender cards and accessories. Also covered are the manufacturer's engineering and manufacturing support services.

Hybricon Corp, 410 Great Rd, Littleton, MA 01460.

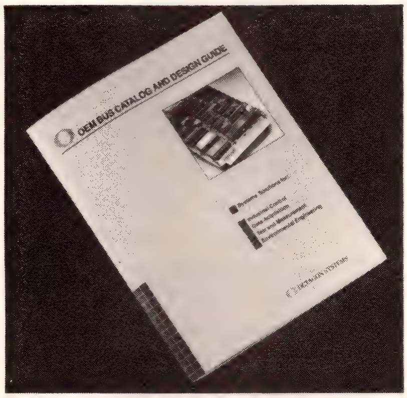
Circle No 409

Brochure covers MIL-STD-1553 products

This 12-pg, 4-color brochure summarizes the company's products for the MIL-STD-1553 data bus. Among the products are bus controllers, remote terminal units, and bus monitors on industry-standard VME Bus, Unibus, and Multibus cards. Also presented are hybrid devices in 2×2-in. packages and building-block hybrids that let you produce any -1553 configuration. The manufacturer's test equipment, including a data-bus exerciser and a benchtop tester, are also covered.

ILC Data Devices Corp, 105 Wilbur Pl, Bohemia, NY 11716.

Circle No 410



Guide supplies information for custom peripheral cards

This 48-pg catalog and design guide provides data sheets and technical specifications for all microcomputers, memories, interface cards, accessories, and complete development systems based on the manufacturer's proprietary OEM bus, which was designed for industrial control, data acquisition, test and measurement, and environmental engineering. A 22-pg design guide describes the physical characteristics of the cards and the electrical characteristics of the OEM bus; these features benefit designers who require application information or wish to build custom peripheral interfaces.

Octagon Systems Corp, 6510 W 91st Ave, Westminster, CO 80030.

Circle No 405

Manual offers user guides to software products

A comprehensive design-software manual suits both users and prospective users of the manufacturer's

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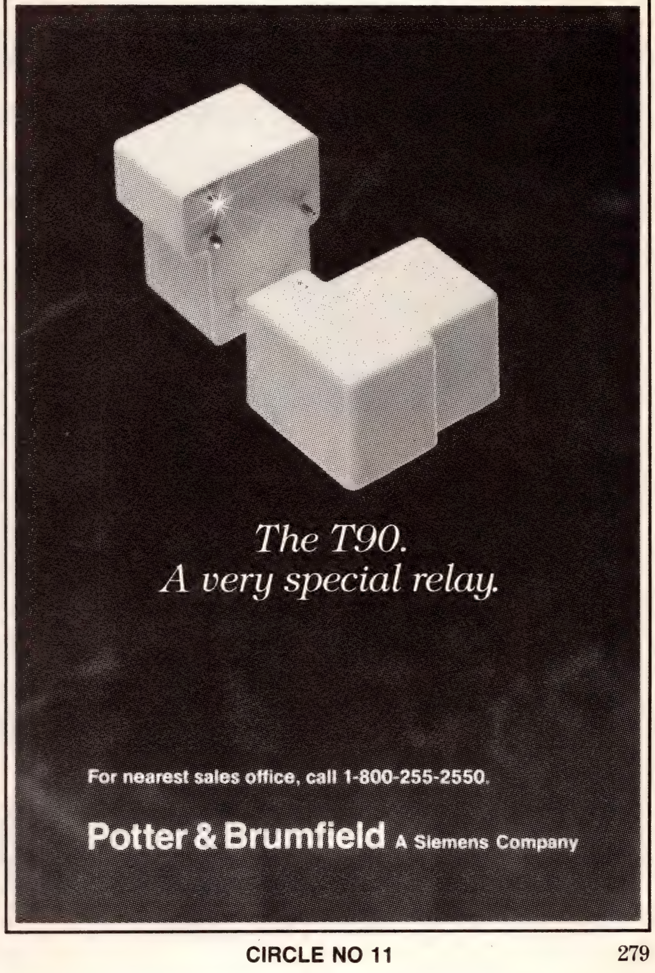

The T90.
A very special relay.
For nearest sales office, call 1-800-255-2550.
Potter & Brumfield A Siemens Company

CIRCLE NO 11

Zyp design system. The 760-pg book offers user guides on 10 of the manufacturer's Zyp software products. The book also includes reference manuals on four Zyp programs. You must request the book on company letterhead.

Zymos Corp, 477 N Mathilda Ave, Sunnyvale, CA 94086.

INQUIRE DIRECT

Guide aids in network planning

This planning and international-standards guide aids designers who use the manufacturer's local- and wide-area network products. The guide features planning information on Primenet, a distributed networking facility that provides local- and wide-area networking for all of the company's systems. Also provided is information on Ringnet, a local-area network, and guidelines on international LAN standards. The 16-pg guide is illustrated with schematics and charts.

Prime Computer Inc, Sales Leads Group, M/S 15-60, Prime Park, Natick, MA 01760.

Circle No 411

Handbook features PC-based data-acquisition products

The data-acquisition and instrumentation special edition of *The IBM PC Enhancement Handbook for Scientists and Engineers* includes tutorial information and descriptions of products and systems for data acquisition, instrumentation control, and process control based on the IBM PC, PC/XT, and PC/AT. The instrumentation section of the handbook covers such topics as controlling instruments through use of the IEEE-488 bus or through serial communications (RS-232C, -422, and -485). It also provides descriptions of hardware and software products that allow you to convert the IBM PC to various laboratory instruments. The data-acquisitions section of the handbook includes information on systems and components for both local and remote applications. $9.95.

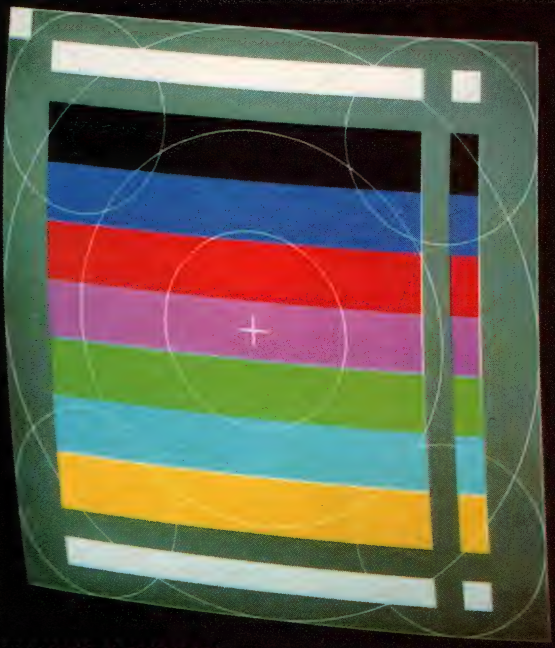
CyberResearch Inc, Box 9565, New Haven, CT 06536.

INQUIRE DIRECT

App note for telecommunications design

Containing 24 pages, this application note presents various implementations for the G65SC150 communications terminal unit, including DTMF dialing, dial-pulse signaling, 0- to 600-baud modems, UARTs, and keyboard scan. The note features a 300-baud modem application and provides detailed programs and diagrams that illustrate the unit's telecommunications-design capability. It also offers design suggestions

You Don't Need a Thousand Words When You Have a Picture Like This!



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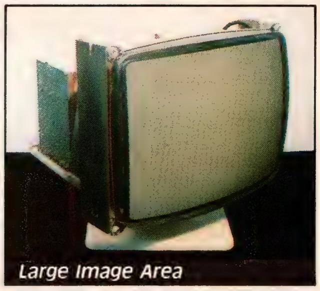
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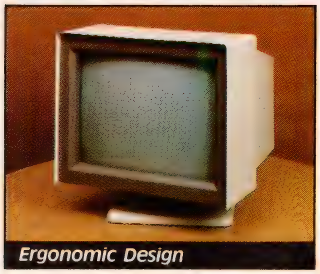
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CIRCLE NO 50

for using the G65SC150 as a clock oscillator and as a reset circuit, as well as for external memory operation, bus expansion, and operation in special low-power modes. It provides a functional system (the G65DS-150 evaluation board) that you can fabricate to evaluate the programs offered.

GTE Microcircuits, Marketing Services, 2000 W 14th St, Tempe, AZ 85281.

Circle No 412

Catalog highlights STD Bus products

This 12-pg short-form catalog gives the principal specifications of the manufacturer's single-board computers, memory boards, I/O boards, and card racks for the STD Bus, grouped into two categories: TTL/NMOS products (MCM Series), and CMOS products (LPM Series). The catalog lists more than 150 products that can directly replace corresponding products from Mostek, Pro-Log, Intersil, and other manufacturers.

WinSystems Inc, Box 121361, Arlington, TX 76012.

Circle No 404

Brochure introduces CAMAC specifications

This 16-pg pamphlet is intended to familiarize the reader with CAMAC, the IEEE-583 international standard for computer automated measurement and control. Suitable as an introduction to the standard's basic specifications, the brochure describes the functions of a CAMAC module, create, and crate controller. It also covers serial- and parallel-highway modes of data transmission, distributed intelligence, and the in-crate Dataway communication flow between process modules and crate controller. Charts and diagrams complement the text.

KineticSystems Corp, 11 Maryknoll Dr, Lockport, IL 60441.

Circle No 415

Latest Cathode Ray Tube Designs For Air Traffic Control Displays

Thomas Electronics is now producing 22-inch metal cone CRT's employing new metal-to-glass sealing technology in our Clyde, New York facility. Tubes are being manufactured for civil and military air traffic control displays for both new and replacement systems. Also available for air traffic control display are the 16-inch and 23-inch all glass CRT's. For the new bright tower display system, Thomas Electronics is now producing a high brilliance, high resolution 16-inch tube employing a bonded narrow band pass filter for maximum contrast enhancement. All sizes, including the 16", 22" amd 23" types can be provided with multi-color voltage penetration screens. Specifications, drawings and our full color catalog is available upon request.

THOMAS ELECTRONICS

100 Riverview Drive, Wayne, NJ 07470 / 201-696-5200
TELEX: 310-685-3326 / FACSIMILE: 201-696-8298

CIRCLE NO 89

Anritsu Presents Spectrum Analysis That's Simply Unforgettable

MS710C Spectrum Analyzer

No more writing down results. No more sketching waveforms on paper. No more grease pencil graphics on the CRT grid. Why?

Because Anritsu's new MS710-series Spectrum Analyzers actually *remember* display screens for you — up to nine of them, in fact. Each one complete with waveforms and comprehensive alphanumeric information such as frequency, level, etc. Each one ready for recall to the CRT at the push of a button. Check and recheck, contrast one with another, even compare the current real-time waveform to a standard in memory. It's like having a file of waveform information always at your fingertips. Frequency range is wide, too; for instance, our new MS710C covers the range from 10kHz to 23GHz (or up to 140GHz with an external mixer). It offers signal search functions, along with an ergonomic front panel that puts every control right where it's needed. A special display lists key functions right on the screen: it's virtually a built-in operator's manual!

Can't get the MS710C out of your mind? Contact Anritsu for further details.

Spectrum Analyzer	Frequency Range	Frequency Stability (6.5GHz)	Frequency Range with External Mixer
MS710C	10kHz~30MHz, 100kHz~23GHz	30kHz	18~140GHz
MS710D	100kHz~23GHz	1MHz	18~140GHz
MS710E	100kHz~23GHz	30kHz	–
MS710F	100kHz~23GHz	1MHz	–

Anritsu

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CIRCLE NO 152

Thermal analysis explored

Reviewing applications of thermal analysis in the electronics industry, this 20-pg report describes state-of-the-art thermal-analysis techniques and shows how you can use the data derived from such analyses to characterize and evaluate electronic materials. Tables summarize the most commonly used techniques and their applications. The text details these applications, which include pc boards, encapsulants, and optical fibers. Among the remaining applications are insulating materials, solder, liquid crystals, and piezoelectric materials. Graphs plot thermal-analyses results. Thermal-analysis instrumentation is also covered.

Du Pont Co, Instrument Systems, Concord Plaza, Quillen Bldg, Wilmington, DE 19898.

Circle No 416

Paper describes how to convert excess noise

A Noise Nomograph will help you convert excess noise ratio (ENR) and $\mu V\sqrt{Hz}$ to power densities and voltages across a specific load impedance. The paper details how you can express the output of a noise source in different ways, depending on system and system frequency. Various examples are included.

Micronetics Inc, 36 Oak St, Norwood, NJ 07648.

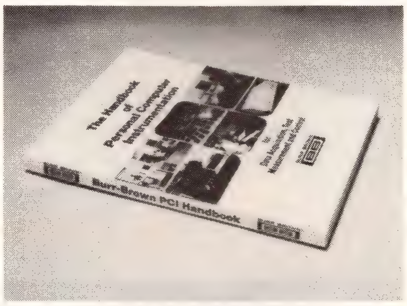
Circle No 417

Brochure describes distributed-control system

This 12-pg full-color brochure introduces the Icon/1000, a distributed-control system for batch and continuous-control applications. Among the features described are the system's computer-aided process-engineering (CAPE) software. According to the manufacturer, CAPE provides an icon-graphics environment that permits a complex process application to be configured without conventional computer-language programming.

Data Acquisition Systems Inc, 349 Congress St, Boston, MA 02210.

Circle No 419



How to use PCs for computer instrumentation

The *Handbook of Personal Computer Instrumentation* contains almost 200 pages and includes a tutorial section that describes the principles of using personal-computer instrumentation equipment for data-acquisition, automated-testing, and measurement and control applications. An applications section provides diagrams and interfacing information for a wide variety of applications, and a software section lists and briefly describes a large number of software packages for instrumentation and analysis. The final sections provide guidelines on how to configure system and technical specifications for some specific personal-computer-instrumentation hardware and software. $9.95 (or free if you request it on your company's letterhead).

Burr-Brown Corp, Box 11400, Tucson, AZ 85734.

INQUIRE DIRECT

Circuit simulator described

Highlighting the capabilities of the Lasar Version 6 simulator, this 28-pg color brochure describes how the system unites VLSI design verification and test-program generation in a common programming environment. The brochure covers use of the simulator for applications in the design and testing of VLSI circuits and pc boards. It details system features, including advanced modeling tools (and a library of device models), the ability to simulate 15 logic states, the ability to perform true worst-case timing analysis, software links that integrate Lasar with commercial CAE tools, and the ability to model test-system attributes.

Teradyne Inc, 25 Drydock Ave, Boston, MA 02210.

Circle No 420

Color booklet details digital multimeters

This 8-pg color brochure covers Series 20 industrial-strength digital multimeters. The brochure explains the design and construction of the instruments. It also includes information on typical applications, a specification table, and a listing of accessories for the meters.

John Fluke Mfg Co Inc, Box C9090, Everett, WA 98206.

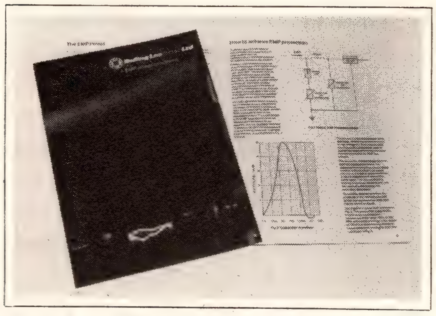
Circle No 418

Users' report covers plotters

This users' report details specific applications of the manufacturer's electrostatic color and monochrome plotters, interfaces, and controllers. The booklet contains seven sections, categorized according to application: scientific/engineering, electrical, mechanical, architectural, engineering and construction, mapping, and geophysical and business graphics. In each section, users describe system features; accompanying photos and output samples are included.

Versatec, 2710 Walsh Ave, Santa Clara, CA 95051.

Circle No 421

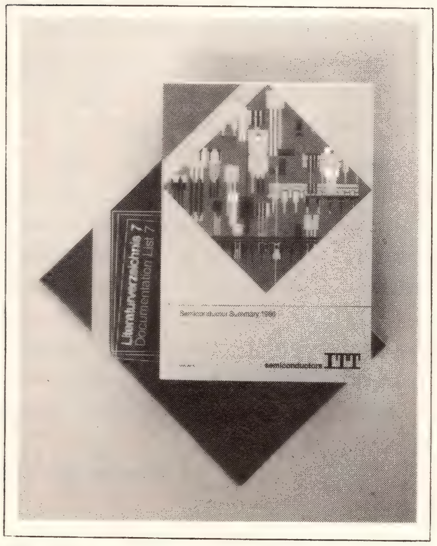


Guide offers protection against EMP radiation

EMP Protection Systems outlines the nature of the electromagnetic pulse generated during a nuclear detonation and its likely effect on electronic circuitry. It examines methods of protection, including the provision of Faraday cage enclosures, transient suppression circuitry, and optically coupled data links, as well as methods of testing their effectiveness. The 12-pg booklet also describes a range of products and test facilities that you can use to develop an effective EMP protection system.

Belling Lee Intec Ltd, 540 Great Cambridge Rd, Enfield EN1 3QW, UK.

Circle No 423



Guide to semiconductors

This 76-page catalog, *Semiconductor Summary 1986*, describes a range of VLSI devices, including single-chip microcontrollers, DSP devices, and special-purpose ICs for digital TV-signal processing, radio, and TV-signal reception. It also describes telephone, electronic-clock, and automotive applications. Listings contain parameters in tabular form, including those for the company's ranges of stabilizer diodes, voltage regulators, bipolar and VMOS transistors, silicon diodes, as well as Schottky, varicap tuning, bandswitching, and zener diodes.

ITT Intermetall, Box 840, 7800 Freiburg, West Germany.

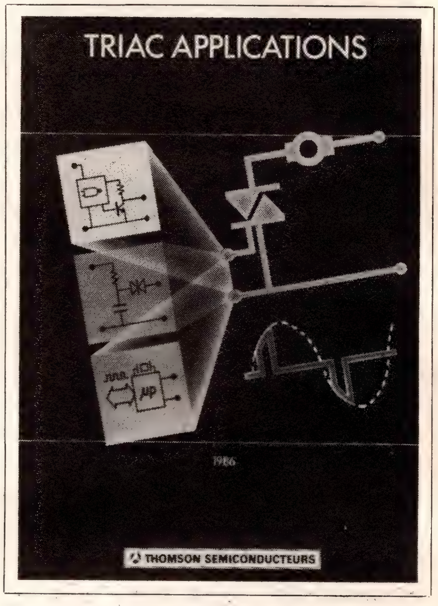
Circle No 425

Catalog lists test and measurement equipment

Covering the company's entire range of test equipment, the *Test and Measurement Catalog* provides data-sheet information on oscilloscopes, waveform analyzers, development and test systems, logic analyzers, microcomputer development systems, recorders, multimeters, and voltmeters. Other equipment covered includes low- and high-frequency generators, audio and video service equipment, counters and timer/counters, pulse generators, TV measuring equipment, microwave equipment, data-logging equipment, and power supplies. An additional chapter deals with the measurement of mechanical quantities.

Philips, Industrial & Electro-Acoustic Systems Div, Test and Measurement Dept, Building TQ III-4, 5600 MD Eindhoven, The Netherlands.

Circle No 426



Designer's guide outlines use of triacs

The 184-page *Triac Applications* manual contains 18 chapters, several of which describe practical applications of triacs for lamp dimmers, solid-state relays, inductive load switching, motor control, and energy conversion. The manual details the parameters you must consider when choosing a triac for a particular application and describes methods of protecting the triac and its control circuitry from overvoltage conditions on the ac supply. Other chapters deal with μP control of triac triggering, thermal resistance, mechanical assembly considerations, and triac reliability.

Thomson Semiconductors, 43 Avenue de l'Europe, 78140 Velizy, France.

Circle No 424

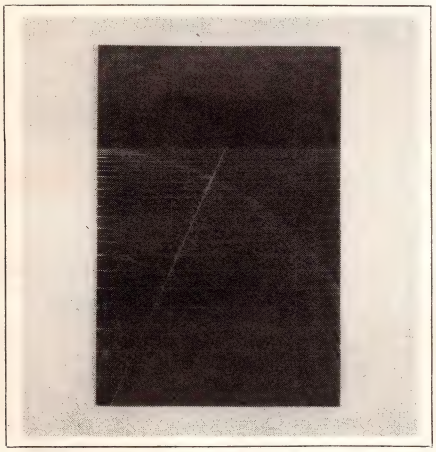
Choosing transistors, diodes

The *Selection Guide to Transistors and Diodes* indexes devices by type number and application. It details small-signal, switching, pin, tuning, GaAsP reference, zener, suppressor, and rectifier diodes. Transistors described include audio-frequency and general-purpose types; HF, broadband and video transistors; dual-gate MOSFETs; and dual-gate GaAs MESFETs. Transistor

sections also cover power types for audio-frequency, switching, high-voltage, and high-reverse-voltage applications. The 38-pg booklet gives package information for all devices; manufacturer cross-reference charts are included for power and video transistors and diodes in sinter-glass packages.

Telefunken Electronic, Box 1109, D-7100 Heilbronn, West Germany.

Circle No 427



Catalog of industrial-control, measurement equipment

Available in English- or German-language versions, the 78-page *Mess- und Regelungstechnik (Measurement and Control)* catalog includes ranges of industrial indicators, process controllers, and test and measurement equipment. Industrial-control and -monitoring products include analog and digital panel meters, chart recorders, signal-conditioning modules, a modular µP-based process controller, and regulators for a wide variety of process parameters. The test and measurement section describes analog and digital multimeters, meters for a variety of specialized physical parameters, oscilloscopes, logic analyzers, transient recorders, plotters, and pen recorders.

BBC-Mettrawatt/Goerz, Box 1333, 8500 Nuremberg 50, West Germany.

Circle No 428

Compendium of measuring equipment

Available in English, German, or French versions, this 468-page catalog of measuring equipment has chapters of data-sheet information on AF and RF signal generators, radio test assemblies, sweep generators/testers, network analyzers, logic test equipment, voltmeters, and power meters. Further chapters detail radio-transmission test equipment, oscilloscopes, X-Y and Y-T recorders, acoustic test equipment, terminations and attenuators, frequency- and time-standard systems, and power supplies. A special section deals with automated testing.

Rohde & Schwarz GmbH & Co KG, Postfach 801469, 8000 Munich 80, West Germany.

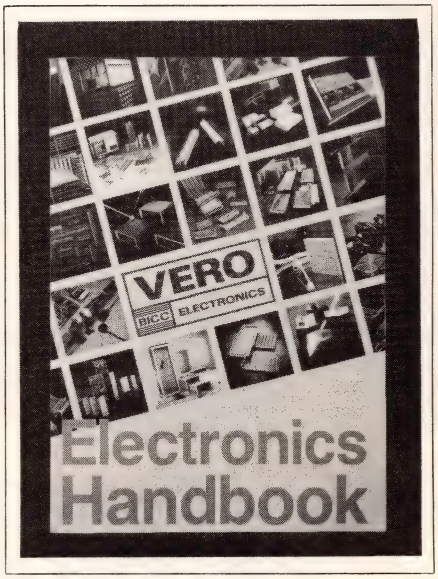
Circle No 430

Guide to telecomm ICs

ICs for Telecommunications is a 47-page brochure detailing a range of ICs for use in telephone sets, telephone exchanges, and ISDN networks. Telephone-set ICs described include devices for simple analog handsets and for microcontroller-based feature phones. The section on telephone-exchange ICs describes an interface between analog subscriber lines and a digital telephone exchange using the PEB2060 signal-processor codec filter and the PEB2050/51 peripheral-board controller. It also covers telephone channel routing, PCM-signal frame-alignment ICs, and advance information on interface and control ICs for ISDN networks. A final section details the company's ECL- and TTL-compatible gate-array family.

Siemens AG, Zentralstelle für Information, Postfach 103, 8000 Munich 1, West Germany.

Circle No 432



Catalog of hardware and interconnect components

The 480-page *Electronics Handbook* combines the products of the company's electronics-packaging, circuit-board, and connector divisions into one publication. The 14 sections deal with circuit boards, wiring systems, power supplies, µP support hardware products, Eurocard subrack systems, metal and plastic enclosures, and a variety of connector systems. A final section covers the company's custom systems and subassembly services. The book includes full ordering information, material specifications, and available options.

Bicc-Vero Electronics Ltd, Flanders Road, Hedge End, Southampton SO3 3LG, UK.

Circle No 431

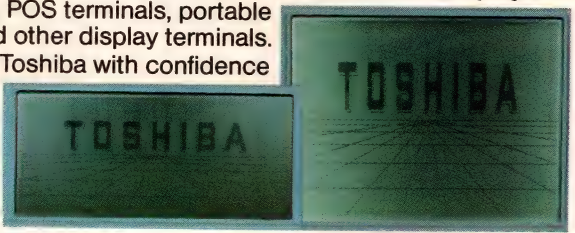
2,000 sharper-than-ever characters all on a portable LCD display.

Toshiba's newest LCD modules give you 640 × 200 dot displays in a choice of two viewing sizes. One is approximately the size of a magazine, and the other about half that size.

Both sizes put an enormous amount of information on view . . . an array of 80 characters × 25 lines. But still bulk and power consumption are at a minimum. Battery powered, these slim modules interface with various systems through LCD controller without renewing software.

Toshiba's advanced technology has also eliminated surface reflection and developed a sharper contrast which gives a brighter and easier to read viewing screen. And for low light or dark viewing an optional backlightable LCD is available.

These versatile LCDs are ideally suited for applications as displays for personal computers, POS terminals, portable word processors and other display terminals. You can also look to Toshiba with confidence for a wide range of sizes and display capacity to suit your LCD requirements.



TLC-363 *TLC-402*

Specifications

		TLC-402	TLC-363B
Display			
Number of Characters		80×25 (2,000 characters)	80×25 (2,000 characters)
Dot Format		8×8, alpha-numeric	8×8, alpha-numeric
Overall Dimensions (W × H × D)		274.8×240.6×17.0 mm	275.0×126.0×15.0 mm
Maximum Ratings			
Storage Temperature		-20° ~ 70° C	-20° ~ 70° C
Operating Temperature		0° ~ 50° C	0° ~ 50° C
Supply Voltage	VDD	7 V	7 V
	VDD – VEE	20 V	20 V
Input Voltage		0≤VIN≤VDD	VSS≤VIN≤VDD
Recommended Operating Conditions			
Supply Voltage	VDD	5±0.25V	5±0.25V
	VEE	-11±3V Var.	-11±3V Var.
Input Voltage	High	VDD – 0.5V min.	VDD – 0.5V min.
	Low	0.5V max.	0.5V max.
Typical Characteristics (25°C)			
Response Time	Turn ON	300 ms	300 ms
	Turn OFF	300 ms	300 ms
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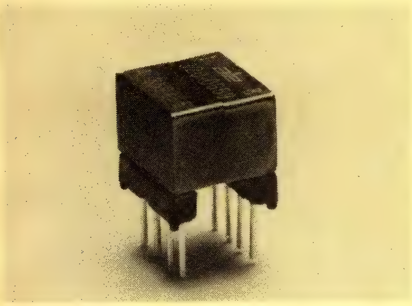

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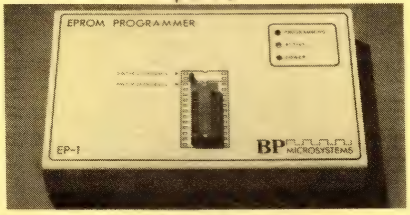

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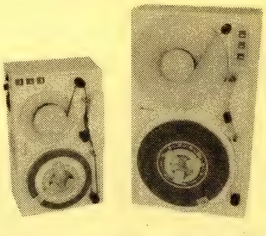

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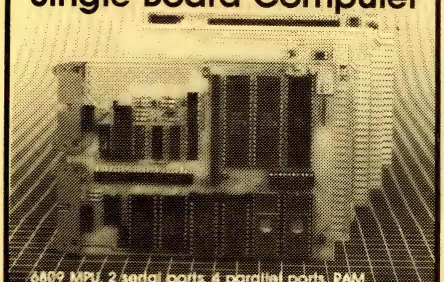

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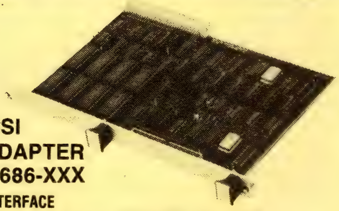

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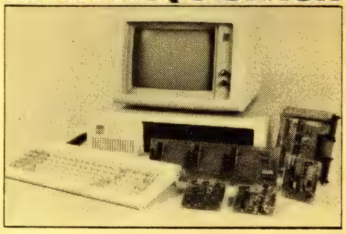

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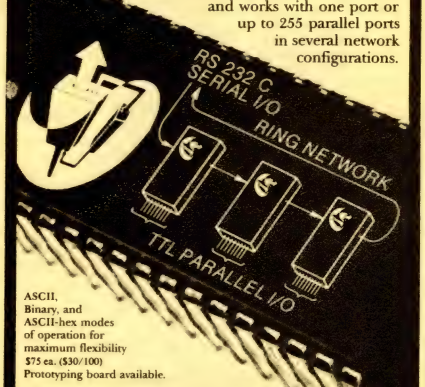

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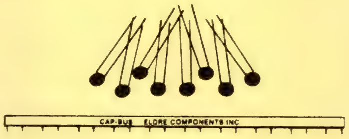

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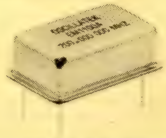

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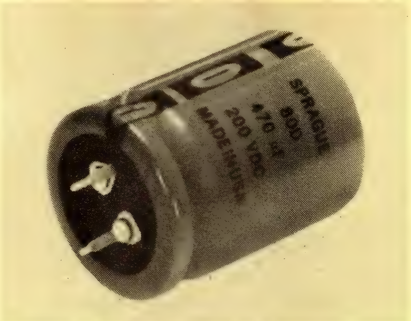

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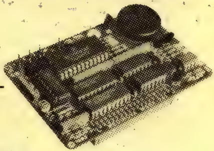

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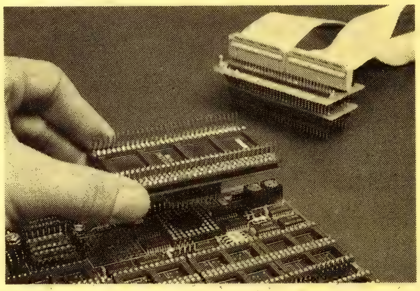

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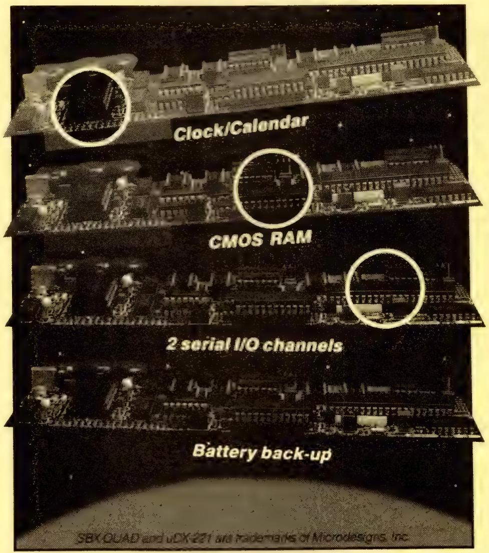

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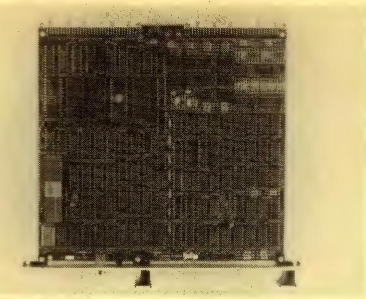

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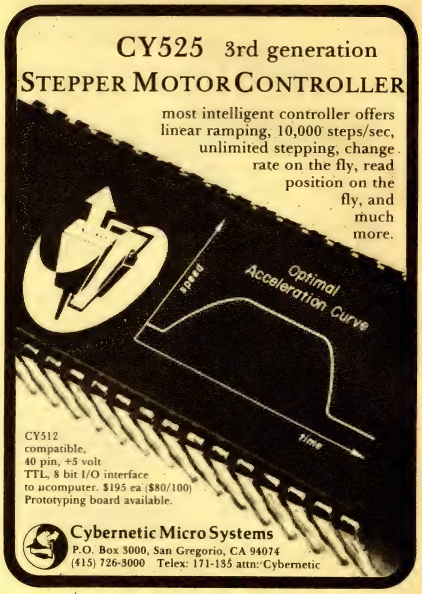

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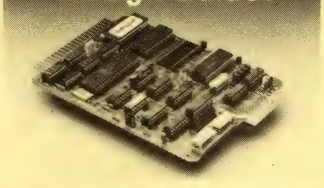

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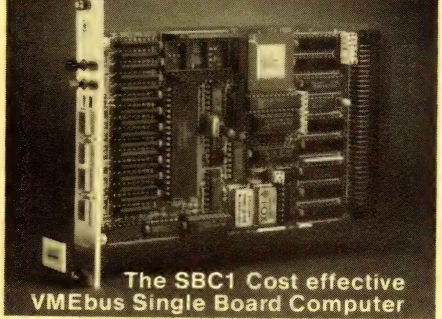

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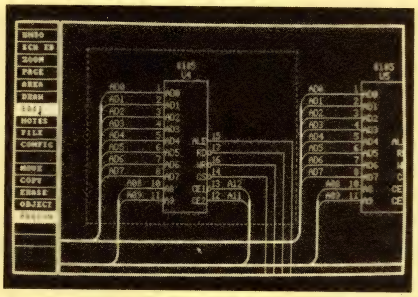

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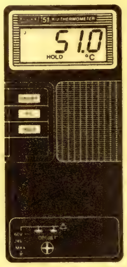

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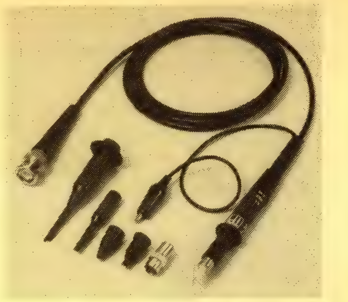

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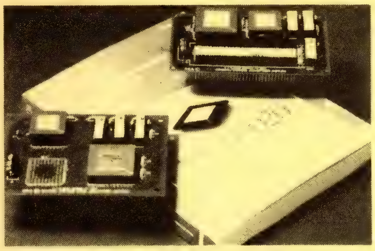

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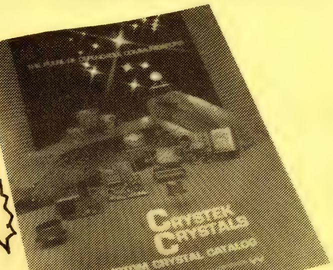

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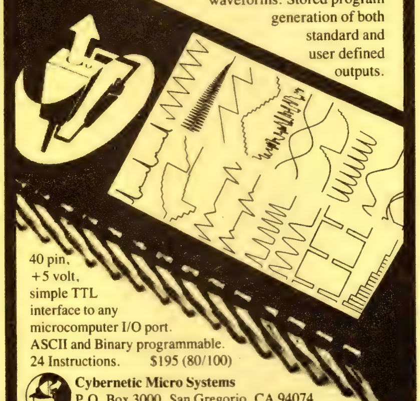

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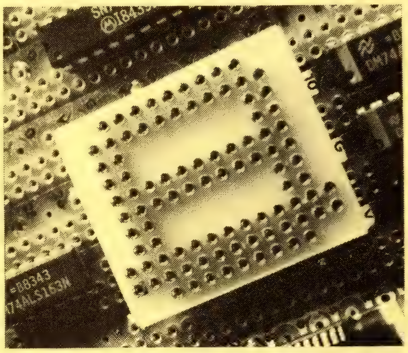

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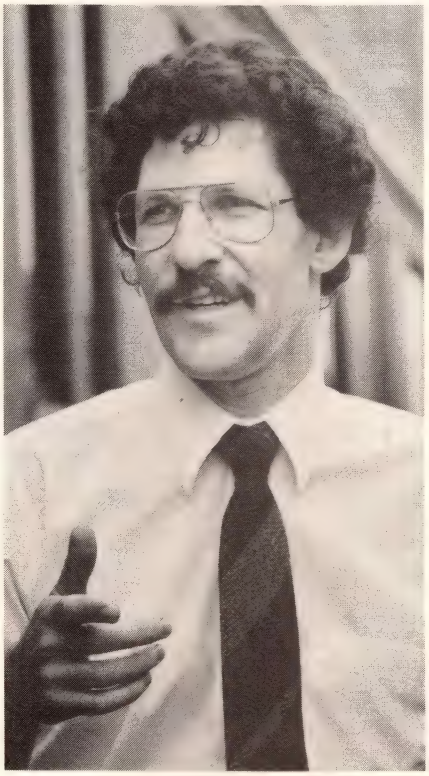
As engineers' social consciousness matures, concerned groups act as the guiding light

Deborah Asbrand, *Staff Editor*

When Alan Hochberg was a sophomore electrical engineering student at Princeton University in New Jersey, he was offered a plum summer job working for IBM. Hochberg was flattered and excited by the offer until he found out more about the project to which he would be assigned: designing a computer for use in a missile-guidance system. Unsure of whether he wanted to apply his budding technical skills to the design of weapons, Hochberg turned to friends and classmates for help in making his decision. After weighing his concerns, he declined the job.

"What was apparent to me at that time was that there was no organization that gave you the opportunity to [discuss] the moral and ethical implications of your engineering work," says Hochberg, now a product manager for a Cambridge, MA, manufacturer of medical instruments.

In the last 10 years, however, several groups have formed with just this goal in mind. Their memberships are small and their visibility is low compared with large, established technical societies like the Institute of Electrical and Electronics Engineers (IEEE). But the groups' message for engineers and other technical professionals is clear: They don't seek to convert engineers into social activists, only to spur them to stop and think about the implications of their work and the choices that they have as individuals in the areas in which they apply their technical skills.


Ted Fitzgerald

Alan Hochberg, product manager: "It was bothersome to some of us that [engineers] were working on weapons. But it bothered all of us that they were doing it without thinking about it."

The oldest of these groups is actually a part of the IEEE. The Society on Social Implications of Technology (SSIT) was one of the earliest forums organized for engineers' discussion of technology and society. The SSIT joined the ranks of the IEEE's 30 technical societies in 1979, having existed as a committee for 10 years before that. The group's discussions cover governmental secrecy and how it affects engineers and society, military issues like the Strategic Defense Initiative (SDI), technology's role in world peace, and technology's assistance of elderly and handicapped persons.

Although the society does not sponsor an annual event of its own, it frequently sponsors individual sessions at technical conferences and trade shows. For example, in May it sponsored a session on SDI at the trade show Electro in Boston, MA. In September, the SSIT will cosponsor the Conference on Humanizing Technology at the University of Kentucky in Lexington. The SSIT also publishes the quarterly *IEEE Technology and Society Magazine.*

Seeking to address the specific professional and ethical questions of engineers working in the military sector is the High Technology Professionals for Peace (HTPFP). The small, Brookline, MA-based organization was founded in 1981 by four friends who wanted to establish a self-help program for engineers. Through monthly meetings and individual sessions, the group serves as a sounding board for engineers to discuss the personal and social ramifications of work on products backed by military funds or having military applications.

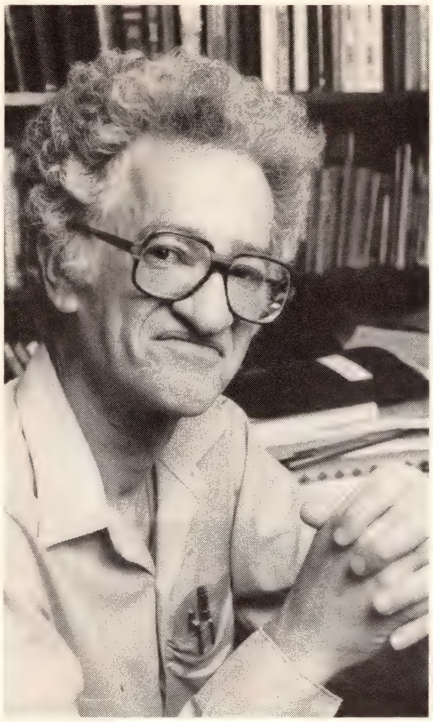
HTPFP president Alex Brown saw the need for such an organization as a result of his own engineering experience. Working as a systems engineer at Data General in the late 1970s, Brown became frustrated by the increasingly military direction that his two areas of technical interest—image processing and pattern recognition—were taking. Brown found that continued work in the two technologies would mean that nearly all of his opportunities would be on projects with military applications.

"Almost everyone working as a scientist or engineer on advanced technology will eventually come up against the choice of personal involvement in military work," says Brown, now a self-employed software consultant. "It is a fundamental problem in industry." And as the military sector's research and development budget continues to swell, says Brown, more engineers are being assigned to projects with military applications. Brown cites as an example the growth in demand for radiation-hardened components.

The professional malaise that has been documented among engineers in the military and aerospace sectors is actually a "profound concern with their companies' objectives," says Brown. "The concern among engineers [in all sectors of industry] is growing. We want to liberate that concern and make it vocal."

"A lot of people wonder why 50% of engineers calmly go about the business of creating weapons," says Hochberg. He adds that, at the first meeting of HTPFP, "It was bothersome to some of us that [engineers] were working on weapons. But it bothered all of us that they were doing it without thinking about it."

Among HTPFP's original goals was the operation of a nonprofit employment agency to assist individuals in finding jobs in their technical specialties outside military projects. Finding the service costly and difficult to operate on a nonprofit basis, HTPFP disbanded the employment agency in 1984. The group is still committed to the goal of becoming a center for information about nonmilitary technical jobs, and it recently began compiling a database of 600 company profiles. The database includes general information on companies' use of security clearances, military contracts, and the applications of their products. When the database is completed and on line, engineers will be able to access it for information on specific companies or on an area of technology in which they're interested in working. Brown expects to have the database on line this fall.


Ken Kerbs

Stephen Unger, professor of computer science: "It's important that engineers take responsibility for the consequences of their work and not behave like hired hacks."

Assuming a narrower scope of study is Computer Professionals for Social Responsibility (CPSR), a Palo Alto, CA-based group that focuses its efforts on computer reliability and the disarmament of both strategic and tactical weapons. The organization first took form as an electronic-mail network among researchers at Xerox Park in Palo Alto. The network's participants met informally in 1981 and later held a public meeting at Stanford University in 1982.

CPSR has devoted its energies to developing technical expertise on computers and weapons. Its research has been published through the Congressional Office of Technology Assessment, and its members have testified at hearings on Capitol Hill. Last year CPSR cosponsored the well-publicized debates at the Massachusetts Institute of Technology and Stanford University on the proposed Strategic Defense Initiative. As a result of the publicity generated by the debates, CPSR is earning a reputation as a leader in the movement against the proposed space-based defense system. On the group's docket for future research are the issues of civil liberties and privacy.

All three organizations maintain small memberships. HTPFP counts 300 dues-paying members. CPSR is larger, with approximately 1100 members paying the organization's annual dues of $30. The IEEE SSIT has the largest membership of the three groups with 2500 members. Still, this figure is just 1% of all IEEE members.

There are several reasons why the three organizations' memberships are small. Representatives of HTPFP and SSIT say lack of publicity about the groups keeps their membership rolls low. "I'm sure that a large percentage of IEEE members aren't even aware of our existence," says SSIT chairman Stephen Unger.

In addition, the perception of such organizations as fringe groups rather than as organizations with engineers' professional interests in mind may depress membership. Yet representatives of SSIT, HTPFP, and CPSR stress that they are professional organizations committed to the education of their members and the public. HTPFP's Brown, for example, describes his organization as "mainstream," concerned with its members' questions of professional ethics and career choice. Stephen Berlin, a regional coordinator for CPSR and a member of its Boston chapter, says that although his organization is "struggling with being viewed as a peace organization, we're really a professional organization with disarmament interests." Berlin adds that the group's educational scope extends to individuals in the computing profession, the public, and the decision makers in government.

But the most important reason for many engineers' seeming indifference to the issue of technology's impact on society goes deeper: For experienced engineers who have invested many years in their careers, it can be a wrenching experience to begin questioning the very work on which their careers have been based. Professional self-examination is "frightening to those already professionally committed," says Unger. "Their entire careers have been spent in technology. When doubts begin to come up, it's an agonizing dilemma."

Engineers' social responsibility

Despite the potential for such anguish, however, many believe that engineers have a special duty to question the ultimate goals of their labor. Engineers' positions at the vanguard of technology, says Unger, assign to them the role of watchdog for society. "We're the first to appreciate the implications of the work we're doing, and we're the first to see when things are going wrong," he says. "It's important that engineers take responsibility for the consequences of their work and not behave like hired hacks. This is an unprofessional attitude, and one that is potentially disastrous to society."

Engineers have been slower than members of other science-based professions to organize into groups to discuss their social responsibilities. Pugwash, for example, is an international association of scientists founded in 1956 and dedicated to the cause of world peace. Another group, Physicians for Social Responsibility, was begun in 1961 and now counts 35,000 physicians as members in its efforts against nuclear war. It is the US affiliate of the International Physicians for the Prevention of Nuclear War, which won the Nobel Prize for peace in 1985.

Some observers attribute engineers' laggard pace in forming social-impact organizations to their close ties to industry. Scientific researchers often work in the freer environment of colleges and universities, but engineers' employment opportunities are largely in private industry, where intellectual freedom often comes second to corporate goals. Although engineers often identify themselves with corporate management, their jobs are much less secure, says Arthur Fink, a leader of the Boston Computer Society's Social Impact Users Group.

Fink cites the aerospace industry's mass layoffs of engineers in the late 1960s as an example of the profession's economic vulnerability. "You can't think about change unless you have an alternative. And engineers have few [employment] alternatives," so it's difficult for them to question their use of technology, says Fink.

A consuming profession

But Unger, like others, is quick to add that engineering is not the only profession that has been slow to examine the social ramifications of its members' work. "It may be that engineers are getting a bum rap," says Unger. "I don't know that accountants and lawyers are particularly socially responsible." Admittedly, engineering is a demanding profession, one that consumes many hours of work and energy and, increasingly, many additional hours of study to keep up with the latest advances. "Those of us that like engineering have a tremendous fascination for technology and tend to forget its social implications," admits Unger.

The technical professions, however, appear to be poised for change. For example, despite never having conducted a membership drive, CPSR's membership has doubled since January of 1985. Moreover, Unger, a computer-science professor at Columbia University (New York, NY), says that students enrolled in his elective course on technology and society are much more responsive to the idea of engineers' social responsibility than were the students of several years ago. The course allows students to see the tie between the humanities and techni-

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cal disciplines, says Unger, and thus between the technical and social aspects of their lives.

Hands-on assistance

One group that has taken engineers' concerns about applications of technology and channeled them toward direct social service is TecNica, a Berkeley, CA-based organization. TecNica provides assistance to the government of Nicaragua in the form of US engineers, computer professionals, and machinists who visit the country for short periods. Since its founding in 1984, TecNica has sent 240 people to assist the Sandinista government in making optimum use of its computers and to teach technical courses. The Reagan administration's economic embargo against Nicaragua does not extend to such technical assistance, says program director David Creighton.

TecNica volunteers spend two weeks in Nicaragua, usually using their annual vacation leave, and pay their own travel and living expenses. "The organization is interesting because our volunteers are generally not political people," says Creighton. "They've never had experience with Third World development projects before." Creighton says TecNica volunteers come from diverse backgrounds and hold opinions that span the entire political spectrum.

Charles Welch, a research engineer at MIT and former test engineer, first read about TecNica on an MIT bulletin board. He spent two weeks in Nicaragua in May of 1985. In the country's capital of Managua, Welch worked for the federal agency responsible for training computer operators, setting standards, and managing the government's computers. Among the agency's equipment was a variety of American microcomputers from such manufacturers as IBM and Commodore.

Gary Benenson, a former design engineer of both digital and analog products and now a teacher at New York City Technical College, visited Nicaragua in July of 1985. Benenson was assigned to teach staff technicians who repaired computer terminals for a government agency.

Benenson found his experience was a way for him to integrate his love of technology and his concern for social issues. As a technical person and as someone involved in social issues, he says he's often asked why he remains part of a profession that has close ties with the military sector and the design of weapons. "I've never felt that way about engineering," he says. "I've always felt there is a positive side to engineering, and I've tried to develop that through my work in medical equipment and teaching." The trip also gave Benenson a new appreciation for his technical abilities. "I realized the skills I have are of tremendous value, especially to a developing country." **EDN**

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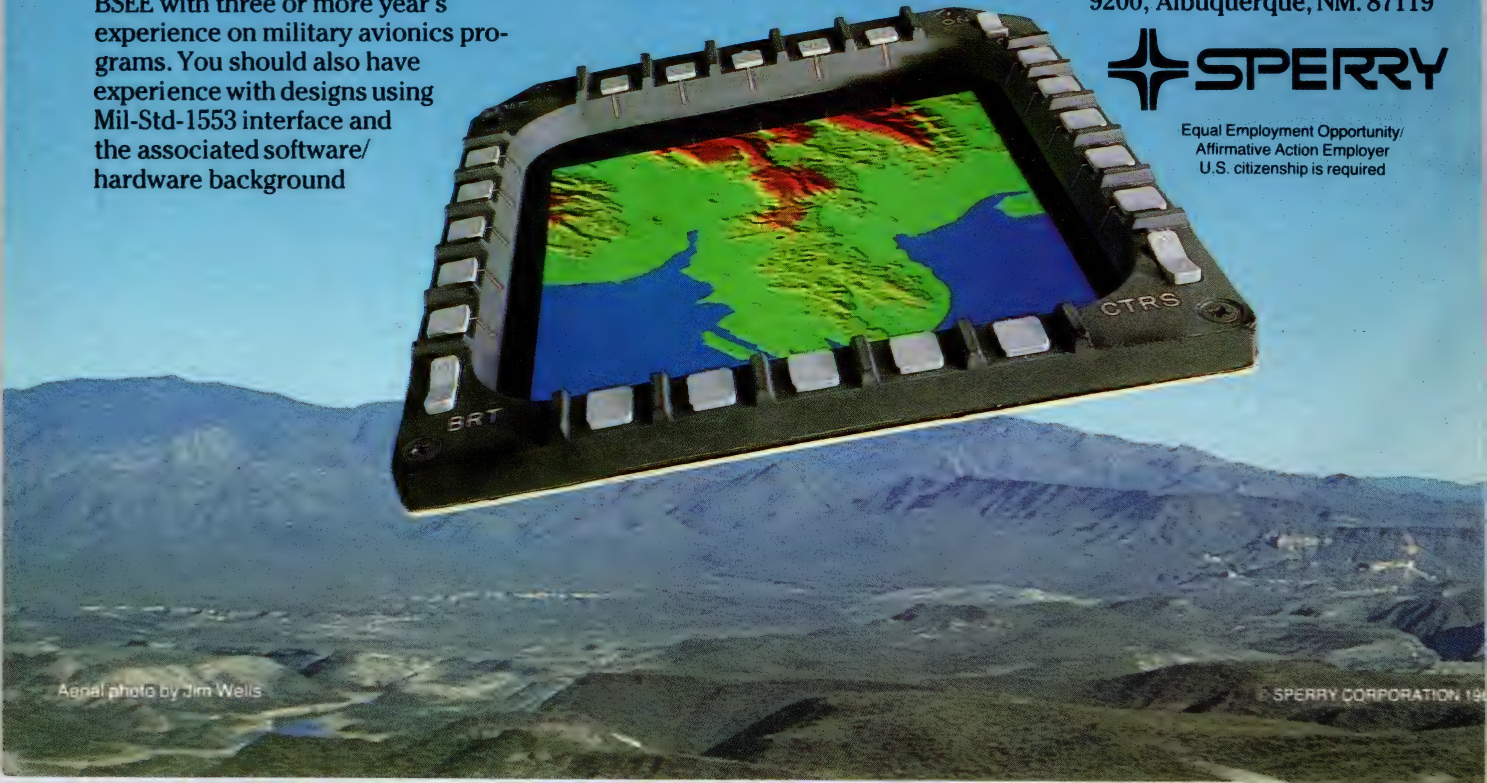

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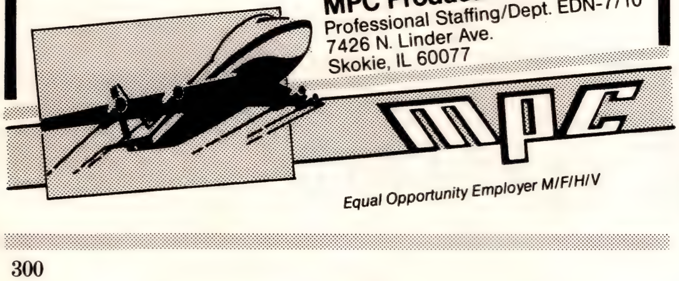

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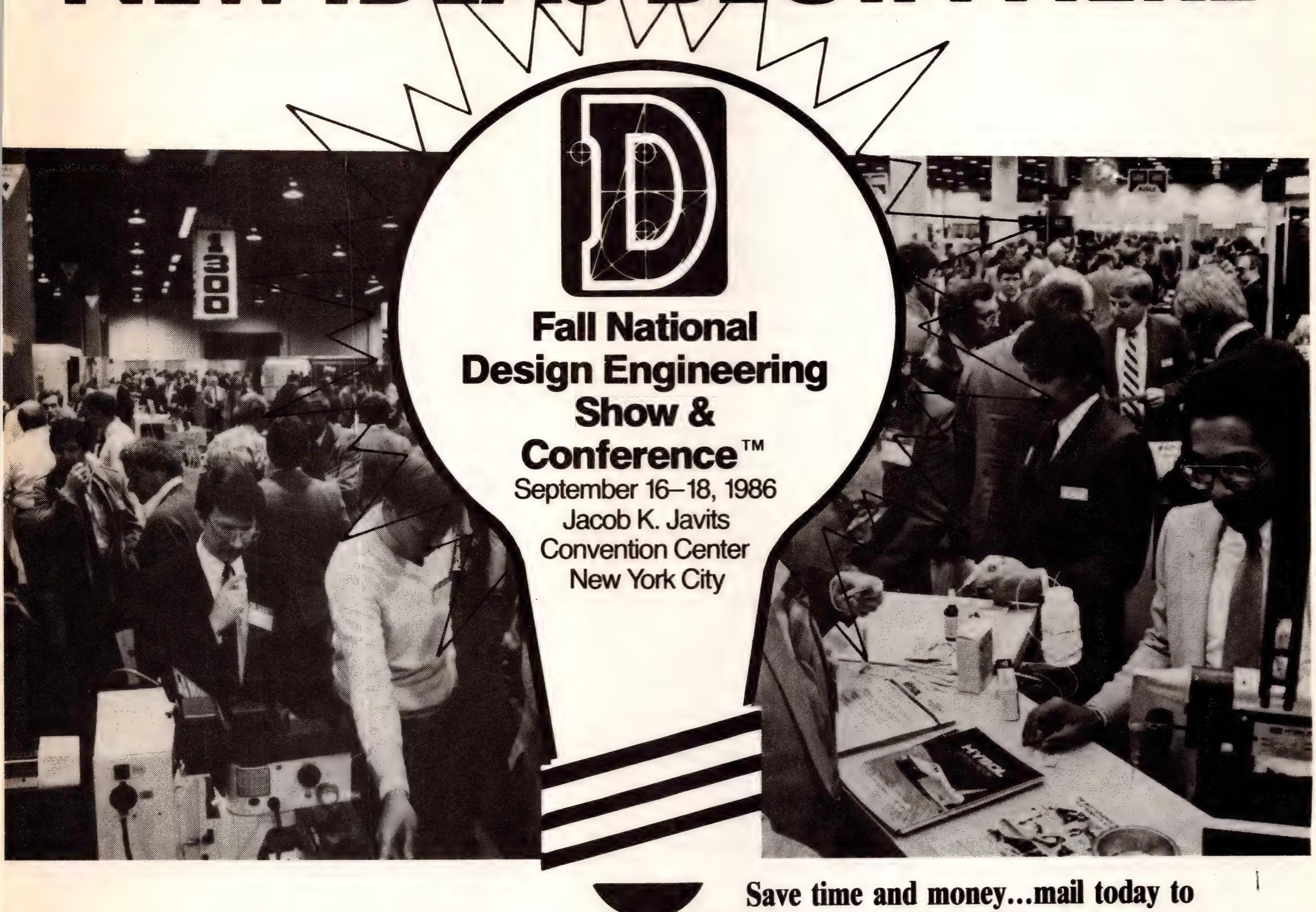

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Advanced Power Corp 210
AIE Magnetics 287
Airpax Corp/Cambridge Div 251
American Research and Engineering 269
AMP Inc 252
Amphenol Products, An Allied Co 220-221
Analogic Corp 274
Anritsu Corp 282
Apex Microtechnology Corp 148
Applied Concepts Inc 289
Applied Control Concepts Inc 288
Archimedes Software Inc 178
Arnold Magnetics Corp 199
AT&T Technologies 119-122
Augat-Fiberoptics 247
Autodesk 177
BBC Brown Boveri 104
Boeing Electronics Co 219
Boston Systems Office 180
BP Microsystems 287
Brooktree Corp 70-71
Burr-Brown Corp 95
B V Engineering 291
Caddock Electronics Inc 163
Cahners Exposition Group 273, 303
Calmos Systems Inc 32
Casio Inc 259
Catalyst Semiconductor Inc 118
Chomerics Inc 261
Cincinnati Milacron/ECM Div 248
Coilcraft 208
Comlinear Corp 147
Computer Products Inc,
  Power Products Div 201
Computer Systems Associates Inc 291
Connecticut microComputer Inc 290
Cooper Group* 229
Corning Materials 250
Crystek Microelectronics 291
Cybernetic Micro
  Systems 117, 288, 290, 291
Cypress Semiconductor 64-65
Dash, Straus, and Goodhue 60
Digelec Inc C3, 287
Digital Equipment Corp* 150-151
DY-4 Systems Inc 290
EDN 271
E G & G Almond Instruments 215
E G & G Reticon 38
Elantec Inc 83
Eldre Components Inc 288
Elgar Corp 212
Emerson & Cuming Inc 126
Emulation Technology Inc 289
Endicott Research Group Inc 216
ENI Power Systems 211
E-T-A Circuit Breakers 209
Exar Corp 68-69
Fairchild Digital Logic 127
Ferranti Interdesign Inc 103
Forth Inc 163
FutureNet/Div of Data I/O C4
GE/Intersil C2
GE Plastics 33
Genstar Rental Electronics Inc 214
Glassman High Voltage Inc 212
Gowanda Electronics Corp 213
Grayhill Inc 215
Greenlee Tool Co 239
Hall-Mark 23
Harris Semiconductor 93
Hewlett-Packard Co 14-15
Hitachi America Ltd* 105-108
Hoffman Engineering Co 235
Hunting Highvolt Ltd 206
Hybricon Inc 227
Hypertronics Corp 249
Hyundai Semiconductor 99
IC Master* 109
ILP Manufacturing Inc 289
Industrial Devices Inc 296
Inland Motor Power Technology Group 196
Inmos Corp 116, 145
Innovative Software Systems 288
Integrated Circuits Inc 289
Integrated Power 112-113
Intel Corp 42-43, 72-73, 128-129
Interactive Circuits & Systems 175
Interface Products Inc 246
International Rectifier 52
Ironwood 291
Jenson Transformers 218
John Fluke Manufacturing Co Inc 6, 291
Jonathan Mfg Corp 255
Kepco Inc 204-205
KMW Systems 257
Lemo USA Inc 245
Logical Systems Corp 290
3M Commercial Chemicals Div 62-63
3M Electronic Products 57
Mactac Industrial Products 268
Matrox Electronic Systems Ltd 164
Maxim Integrated Products 8
MCG Electronics Inc 275
McLean Midwest 253
Medinova Corp 289
Mentor Graphics Corp 28-29
Microdesigns Inc 289
Micro Networks 44-45
Micron Technology 101
Micro Switch* 276
Mini-Circuits Laboratories 24-25, 306
Monolithic Memories Inc 16-17
NEC Corp 115
NEC Electronics Europe** 108-109
Oasys Software 179
Octagon Systems Corp 173, 290
Oki Semiconductor 46
Omation Inc 290
OrCAD Systems Corp 289
Oscillatek 288
Papst Mechatronic 194
Permag Corp 40
Philips Elcoma Div** 46, 110
Philips Test & Measuring
  Instruments Inc** 67, 105
Pittman 246
Plessey Semiconductors 50-51
Polytronix Inc 126
Potter & Brumfield Inc 275, 277, 279
Power-One Inc 193
Power Sonic Corp 217
Precision Monolithics Inc 97
Prem Magnetics 32
Pro-Log Corp 4
Qualstar Corp 287
Quatech 288
Quelo Inc 287
RCA Solid State Div 85-89
Richco Plastic Co 242
Rockwell International 149
Samtec Inc 10-11
Semicon Components Inc 130
Siemens AG** 106-107, 150-151
Siemens Corp* 67
Silicon Systems Inc 124, 125
SLR Systems 290
S-Mos Systems Inc* 110
Softaid Inc 182
Sohio Engineered Materials Co 272
Sophia Systems Co Ltd 39
Sprague Electric Co 30-31, 59, 289
Stag Microsystems Inc 18
Stanford Applied Engineering 234
Sunrise Electronics 140
Supertex Inc 146
Symbolics Inc 184-185
TDK Corp 265, 270
Technitrol Inc 56
Tektronix Inc 34-35, 55, 90
Teledyne Semiconductor 41
Teradyne Connection Systems 236-237
Test Probes 291
Texas Instruments Inc 131-138
Thomas Electronics Inc** 281
Thomson/Mostek 141-144
Toshiba Corp 286
TRW/LSI Products Div 21
Uniform Tubes Inc 40
Union Carbide Corp/Electronics Div 267
Universal Cross-Assemblers 288
Universal Data Systems 61
Uppermost Electronic Industries
  Co Ltd 288
Vicor Corp 207
VideoLog Communications 291
Video Monitors Inc 280
Viking Connectors Co 254
Visionics Corp 183
VLSI Technology Inc 26-27
VME Specialists 290
Wavetek San Diego Inc 3
Wells Electronics Inc 230
Whitesmiths Ltd 170
Wintek Corp 288, 291
Woven Electronics 241
Ziatech Corp 12-13

Recruitment Advertising

Ametek/Orionics Division 301
Cooper Instrument Corp 300
General Electric 299
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LOOKING AHEAD

EDITED BY GEORGE STUBBS

Michael McLaughlin

Circuit-board market growth precedes radical applications

The market for circuit boards—currently valued at $4.5 billion—is expected to double through the next five years, according to the market-research company International Resource Development (IRD) (Norwalk, CT). If this prediction proves true, then the fun will really start, as exotic applications venture outside the laboratory and give new life to a long-standing debate.

IRD envisions a future in which molded-plastic-injection circuit boards take on shapes heretofore thought impossible, and we may even see circuit boards wrapped around the human body, combining with VLSI developments to form a new kind of artificial intelligence. Says Peter Kibler, a senior consultant with IRD, "Intelligence will be built into common objects, and may well be built into the human body someday."

Such an eventuality may or may not help computer scientists and philosophers to clarify the distinction between machine and human intelligence, but it will certainly revive the debate. One of the more surprising of IRD's scenarios recalls a popular technofantasy of the last two decades: As computer systems that bear this symbiotic relationship with the human body become more intelligent, they may come to regard the human body as parasitic. What follows is anybody's guess.

Before such dreams—or nightmares—become reality, the market for circuit boards will have to see better times in the traditional hardware sectors. The expected doubling of the market value is contingent upon good fortunes in several industry areas, including defense and consumer electronics, computers, instruments, and telecommunications. IRD identifies the transition to surface mounting, multilayer boards, and flexible boards as keys to the success of vendors.

MIL-spec connector market to be worth $1.8B by 1990

Assuming a "status quo" scenario, the US market for MIL-spec connectors will grow at a 13.5% annual rate at least until 1990, according to Gnostic Concepts Inc, a San Mateo, CA-based market-research company. The market value will increase from 1985's $939 million to $1.8 billion in 1990. The status quo assumption presumes that there will be no major geopolitical, environmental, or economic changes between now and the end of the decade.

Such assumptions are usually tenuous at best, and Gnostic Concepts has considered the effect of various departures from the status quo on the overall market. The Gramm-Rudman-Hollings Balanced Budget Act, or any other plan to decrease defense spending, obviously could cut into spending on connectors. Other factors threatening to depress vendors' income levels are the potential for bidding wars among suppliers, an increase in the number of overseas manufacturing facilities, the replacement of many conventional MIL-spec connectors with insulation-displacement connectors, an increase in the number of multiyear contracts, or the reduction of prices through implementation of robotic assembly systems, which would cut labor costs.

A few scenarios promise to increase income levels for connector suppliers. Basic materials used to build connectors could suffer shortages, and the consequent higher prices could drive up the cost of connectors. US manufacturers could adopt just-in-time delivery programs on a broad scale, and the shortened lead times could be quite attractive to customers—increasing profit margins as well as total sales. Of course, between now and 1990, there is always the possibility of a war involving the US, or the threat of hostilities, either of which would boost demand for the connectors.

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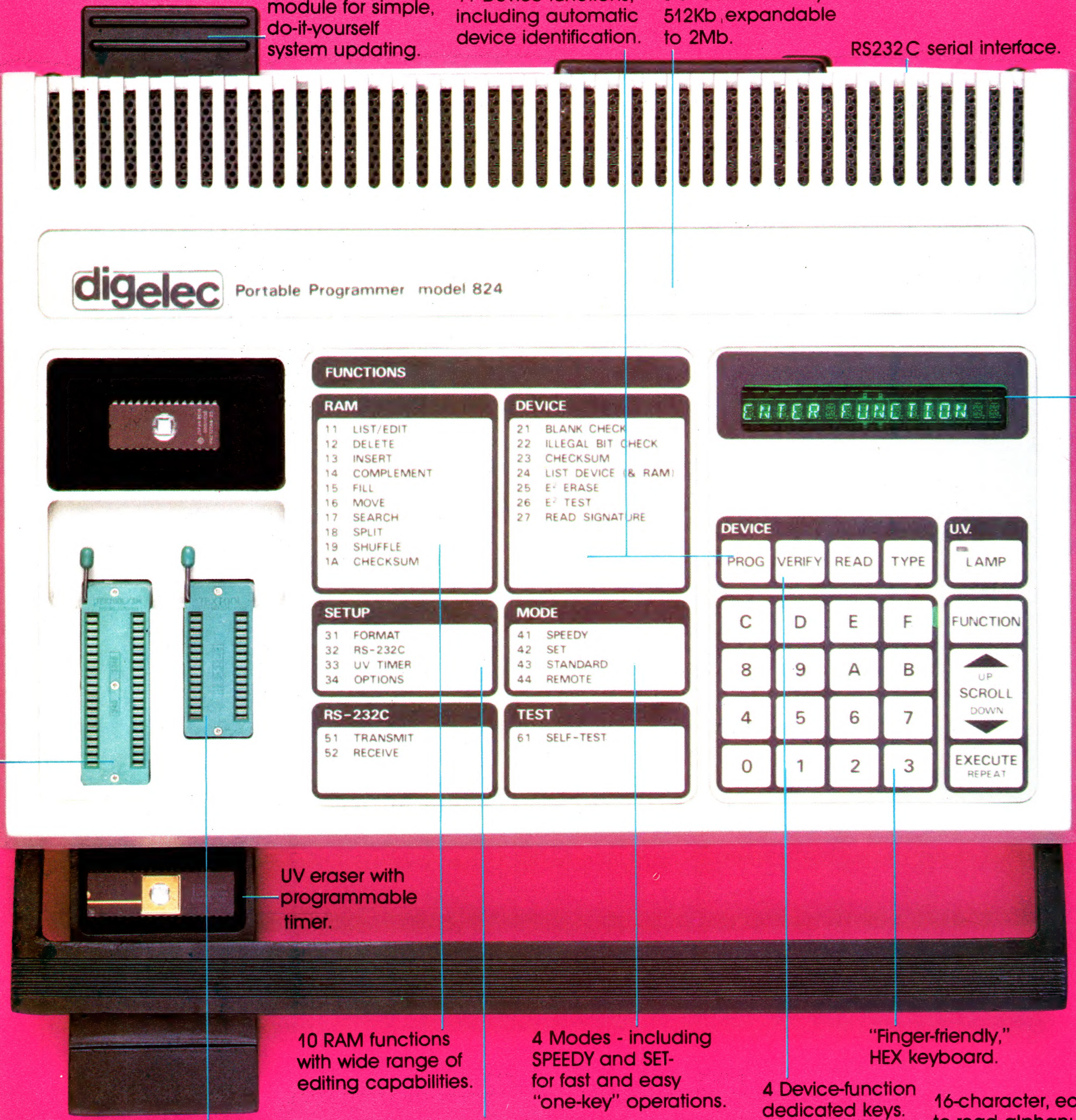

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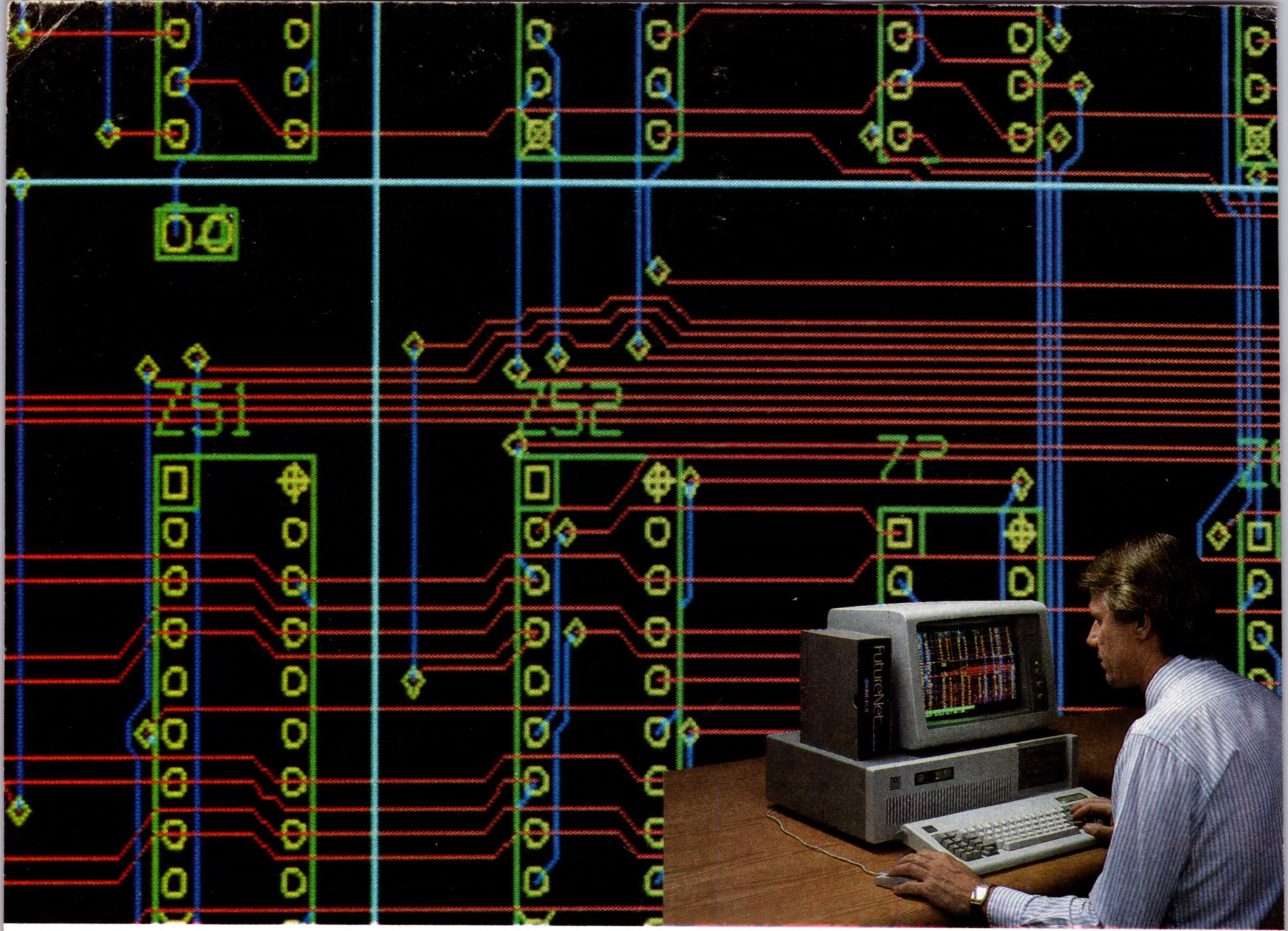
Circle 192 for Demonstration

Circle 231 for Information



EXPERT LAYOUT POWER OF A MAINFRAME ON YOUR PC.

You no longer need a large dedicated workstation to lay out even the most complex printed circuit boards. FutureNet's® DASH™-PCB is the first PC-based layout system to parallel the performance of a VAX-class mainframe. So, you can give your designers the same expert layout capabilities right on their PCs – for a fraction of the cost.

RESULTS OF AN EXPERIENCED PCB DESIGNER, IN ONE-QUARTER THE TIME. Even with minimal experience, you can lay out PCBs four times faster than skilled layout designers can manually. Easy to use and learn, DASH-PCB mimics the experts. A multi-strategy auto-routing system lets you choose from several sophisticated routines to optimize your circuit. Traces are automatically run as closely together as you want and routed at 45 degrees to save board space. Real-time rubber banding helps you find the shortest, most direct interconnect paths. And with switched screens, mouse control, hierarchical menus and command files, you can easily lay out printed circuit boards just like the experts.

SCHEMATICS TO PCB LAYOUT IN ONE CAE SYSTEM. If you're already using the DASH Schematic Editor, you're well on your way to automated PCB layout. The Net List created during schematic editing is used as input to DASH-PCB, allowing you to draw schematics and lay out PCBs within one integrated environment. Throughout auto-routing, the board net list is constantly checked against your original net list. Your final board designs will match your specifications precisely.

WE'LL SHOW YOU HOW TO GET EXPERT RESULTS. Call FutureNet today, and compare our PC-based layout system to any existing methods. You'll find the DASH-PCB gives you the same results as the top designers or expert mainframe programs. The big difference is the time and money you'll save. Our representatives can show you just how much. Contact FutureNet at **818-700-0691**.

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